Concrete

Vol. 23 *Detroit, September, 1923* *No. 3*

Trade Secrets

IT is recorded that a plasterer of medieval times won renown by the marvels of his work and that many tried to learn his secrets. One day he was plied with wine until he led the way to a deep cellar where the secret was disclosed in the prolonged aging of his plaster before use. In those rather gropy days when trades passed from father to son and mechanical and industrial knowledge did not travel swiftly on the wings of the morning, there were trade secrets. Trade secrets are now out of date. Well informed people know that we have made more progress in the last fifty years in these lines of work than in all previous time. It has been accomplished by scientific cooperation and not by trade secrets.

When a man won't cooperate he at once challenges the world. He sets himself up as knowing more than all the rest put together. Take one hundred concrete products manufacturers and put them in a room together. Let each one tell what he has learned. The hundred are all farther along.

There was a time when this "trade secret" nonsense had not been outgrown by some of the cement manufacturers. It is related that in a district where there are many mills in a small area, the executives were posting "keep out" signs and maintaining a lordly aloofness from each other. At the same time the superintendents were swapping experiences and borrowing and loaning tools and things among themselves via the back doors. The men whose job it was to keep things going knew the value of cooperation before their bosses grew up to the idea.

We have in mind two manufacturers of high quality concrete building units—both successful. One of them shows visitors through his plant, tells them all about it, answers their questions and considers it time well spent. The other man (personally a fine chap) practically forbids visitors.

Both these men are pestered a good deal by small competition. A man with just a little capital thinks he can do the big kind of work. He has no conception of the investment which enables these two manufacturers to do fine work. The little fellow takes a plain job at a low figure and beats out the big fellows. Then he tries something else a little complicated and fails miserably. That hurts the whole game. It is the big fellows' ability to do a good job of plain work or complicated work, his mastery of detailing, of model making, his mastery of the whole matter of machinery and organization, that make his work dependable and his price reasonable.

But the chap with five or ten thousand dollars to invest in a quarter or half million dollar game doesn't see these difficulties until they swamp him.

Now, is the big fellow who shows the visitors through his plant, explaining every detail, doing more or less than his secretive competitor, to keep down the undesirable competition? Good competition is good. It helps sell the goods, not your goods but the same kind of goods. It helps sell the idea. A friendly disclosure of the whole detailed operation discourages most of the potential competition at the outset. It removes that poor competition by the spread of knowledge; while the "trade secrets" chap, to his own discomfiture, lets the smaller competitor blunder along.

And the funny thing about trade secrets is that they are almost as scarce as hen's teeth. It has been the job of the writer to try to run a good many trade secrets to their lairs. When the lair is found the trade secret is no secret at all. Some other chap is doing it—probably better. The best trade secret is this: Make as good a product as you can. Success in many lines is just a matter of taking care to do a good job.

Peter's Work for John's Glory

It occurs to us sometimes on looking at some circulars and letterheads that it is a form of dishonesty to advertise one's own work by displaying pictures of other men's work in the same general line of activity—unless the truth is stated along with the picture. If there is no difference in the appearance of the work probably no harm is done. But if Peter Johns has produced something in an original design or with exceptionally good workmanship and John Peters uses a picture of it, without explanation, to call attention to the work he is doing, then John is riding free on Peter's reputation. That is one of the reasons this magazine doesn't loan pictures and cuts sometimes for advertising purposes without knowing how they will be used.

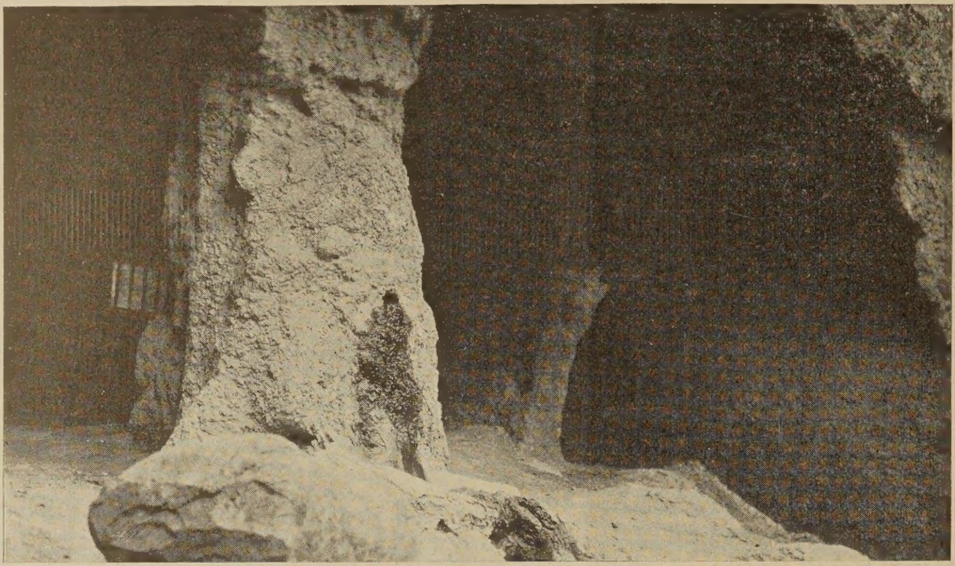


Fig. 6 — Cavern at Back; Showing Grating Between Cavern and Sleeping Quarters, Also Drinking Water for Lions Coming from Main Column Supporting Rail-Concrete Roof

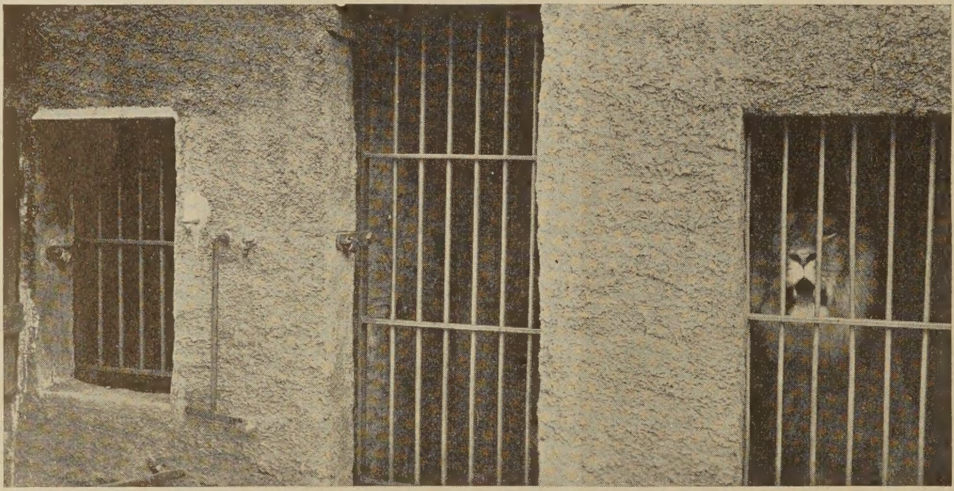


Fig. 7—Close-Up of Gratings at Rear of Sleeping Quarters, Showing Controls for Interior Gratings

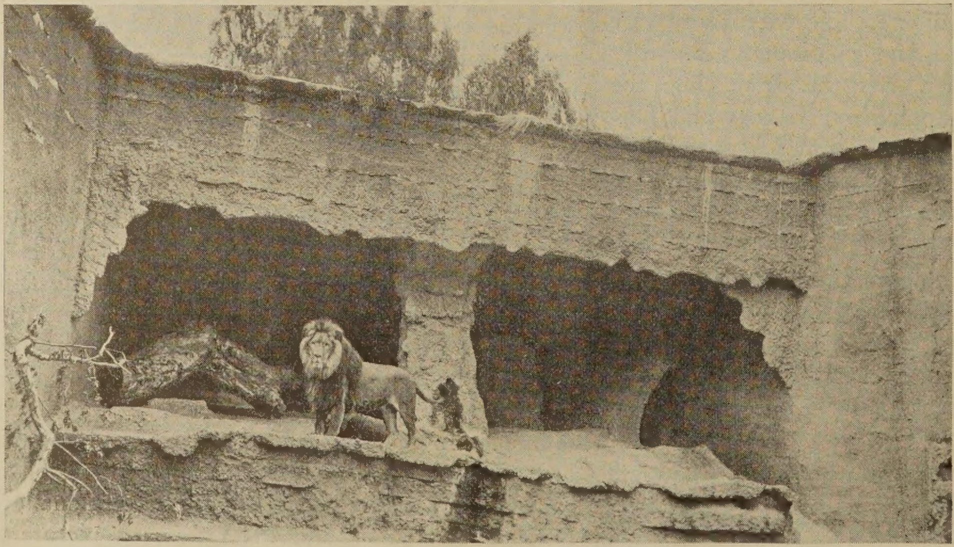


Fig. 8—"Prince," Said to be the Finest Lion in Any Zoo

A Concrete Lion Grotto for the San Diego Zoo

San Diego, California, has planned a zoological garden that is unique, from the rugged topography of its hundred and fifty acres of canyon cleft mesas to the minutest detail of construction. Concrete has been determined upon, not only because it forms the type of construction most substantial and durable, but because of its adaptability to the peculiar topography of the city's magnificent park. Through the public spirit and efforts of a small body of citizens comprising the San Diego Zoological Society, funds have been raised by private subscriptions and membership fees for the rehabilitation of two classic structures remaining in Balboa Park from the Panama California Exposition, and for the construction of a Lion Grotto, reptile houses, compounds for elephants and rhinoceros, a series of dams providing lakes for aquatic birds, seals, alligators, and other denizens of the waters, and for a group of habitations for small animals. The last named, 33 in number, are placed in the form of a hollow square, enclosing a large service yard in which are placed hospital quarters, cold storage plant, feed rooms and other features requisite to the operation of an extensive zoological garden.

The Lion Grotto is of special interest because of its magnitude, and more particularly because of its wide departure from the orthodox methods of lion housing (Figs. 1, 2 and 3). To all appearances, the three magnificent lions in the San Diego collection wander at will over a terraced hillside, with only a three-foot hedge of cactus to restrain them from joining the audience. In reality, concealed by the cactus hedge, a wide moat, 20 ft. in depth, affords a factor of safety 40% in excess of actual need. This method of safely presenting to the public the wonder and charm of the king of beasts, is unique from both the standpoint of the clear, uninterrupted view of the animals by spectators and the freedom of living for the animals themselves. Here, there is no small and confined cage, which invariably challenges sympathy for the animal, nor are there the usual many and heavy iron bars to interrupt the view of interested observers. There is no point in the Grotto where it would not require a 16-ft. leap for a lion to escape from the Grotto, and the top of the walls are built with an interior over-hang of 15 in. to 20 in. as an added factor of safety to prevent the animals from leaping out. The walls on the sides, the dens on the back, and the wide and deep moat or opening at the front of the Grotto, form the necessary protection (Figs. 4 and 5).

The ground covered by the Grotto is in excess of 3,600 sq. ft., being approximately 60 x 65 ft. in extent. The rear quarter of the Grotto is covered, converting this section into a hillside cavern, wherein the animals may seek protection from sun and rain (Fig. 6). At the back of the cavern are sleeping quarters, in which the lions may be closed in case of need, or to which they have access at will under ordinary conditions (Fig. 7). There are six of these dens connected by sliding grating doors, two of them capable of being made entirely dark and designed especially for the use of expectant mother lionesses. All of the dens are provided with doors opening into the main Grotto, also doors through the exterior wall for use in transferring animals to and from the Grotto. Still another door is located in the concealed portion of the main Grotto, for use by attendants, who look after cleaning and other duties in the early morning while the lions are shut in the sleeping dens. The sleeping dens are cleaned during the day while the animals are in the open Grotto.

It is claimed that the convenience and safety of attendants has been more efficiently worked out here than in any similar structure in the country. Doors connecting the sleeping dens with each other and with

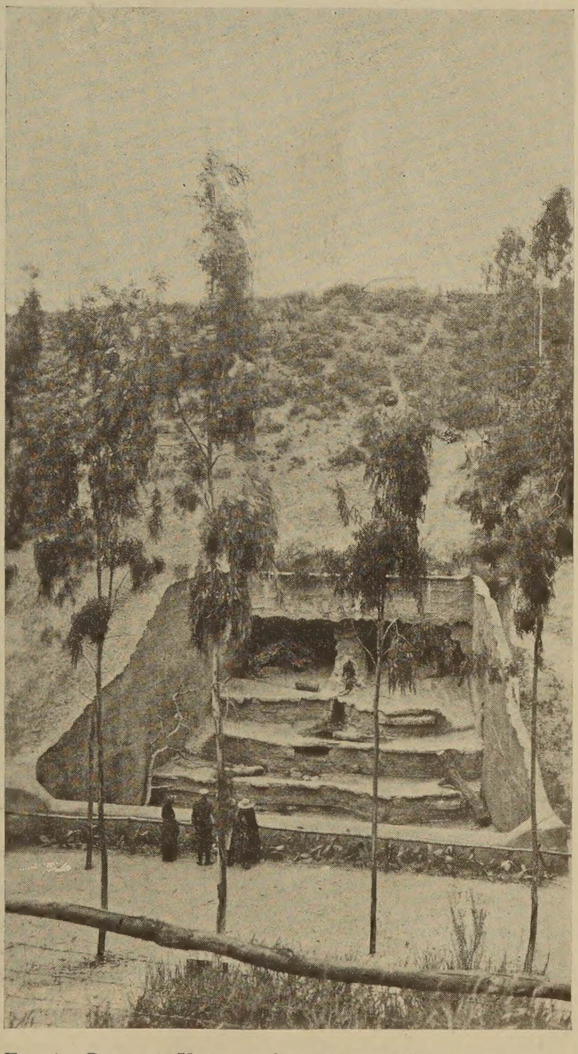
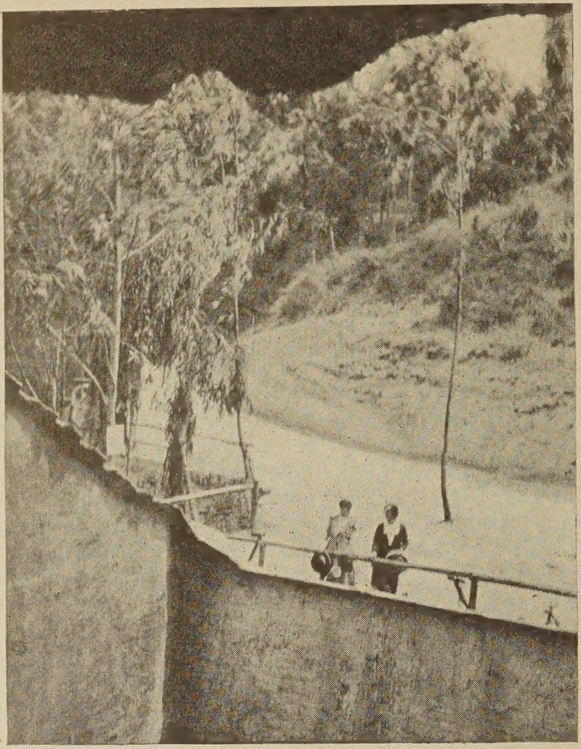


Fig. 1—General View of Grotto from Opposite Side of Canyon



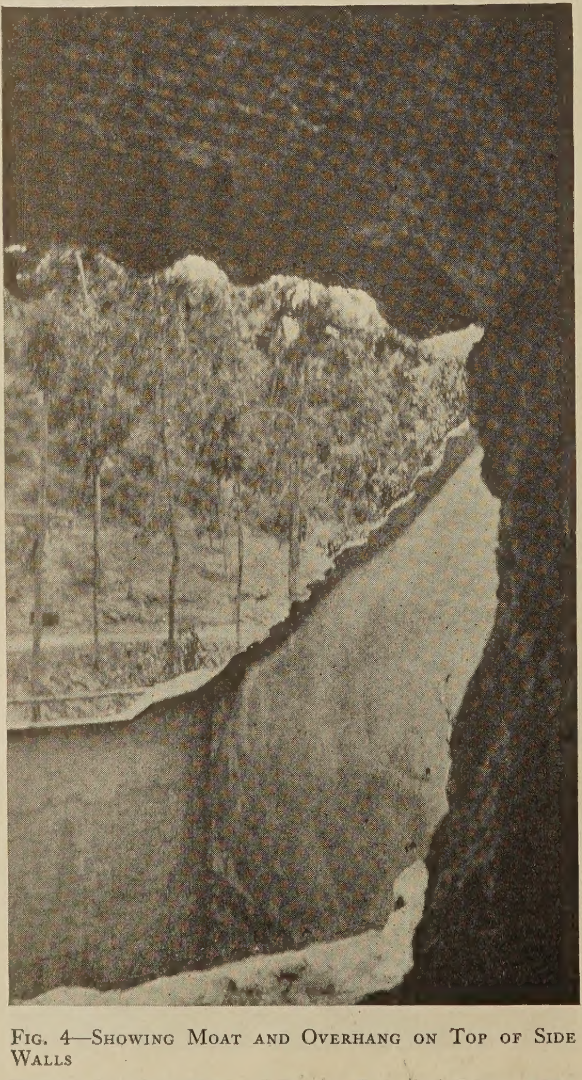
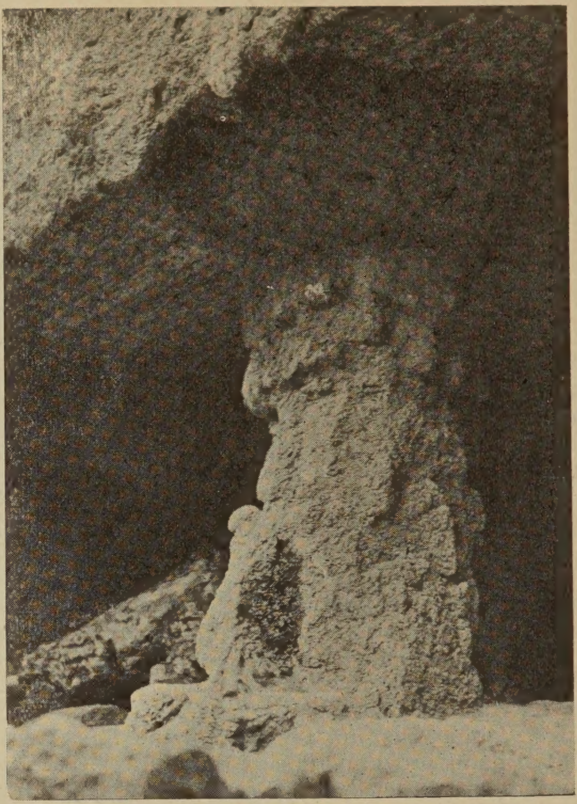


Fig. 4—Showing Moat and Overhang on Top of Side Walls

Fig. 5—Looking Toward Front, Showing Deep, Wide Moat over Which Lions Cannot Leap



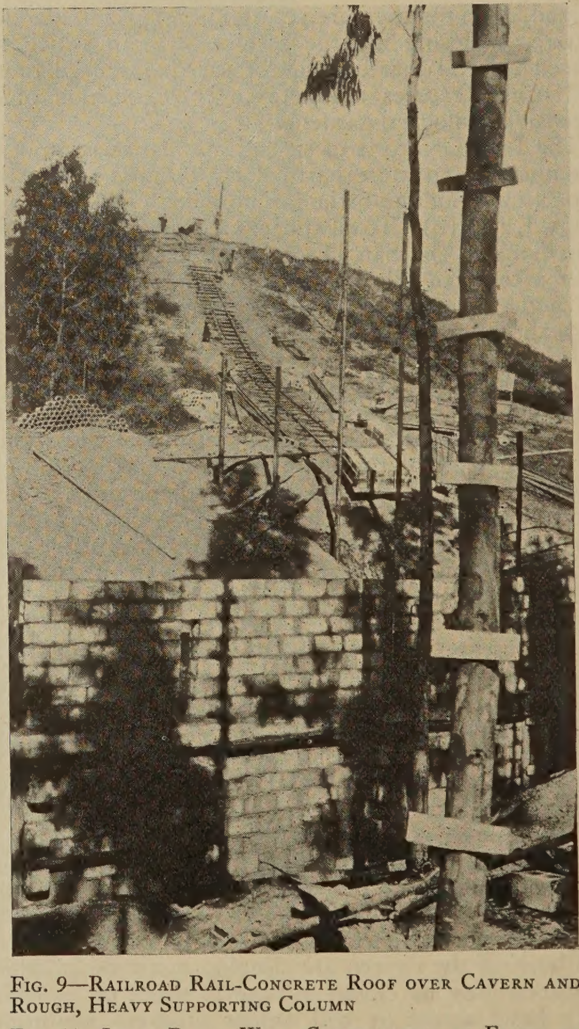


Fig. 9—Railroad Rail-Concrete Roof over Cavern and Rough, Heavy Supporting Column

Fig. 11—Ideal Block Wall Construction in Front of Moat

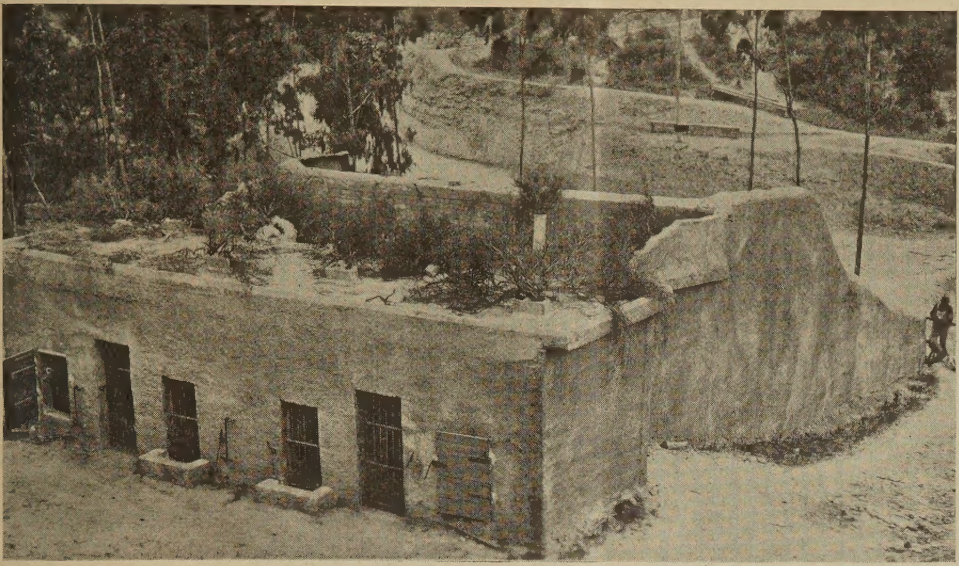


Fig. 2—General View from Rear, Showing Sleeping Quarters, Gratings and Controls for Interior Gratings

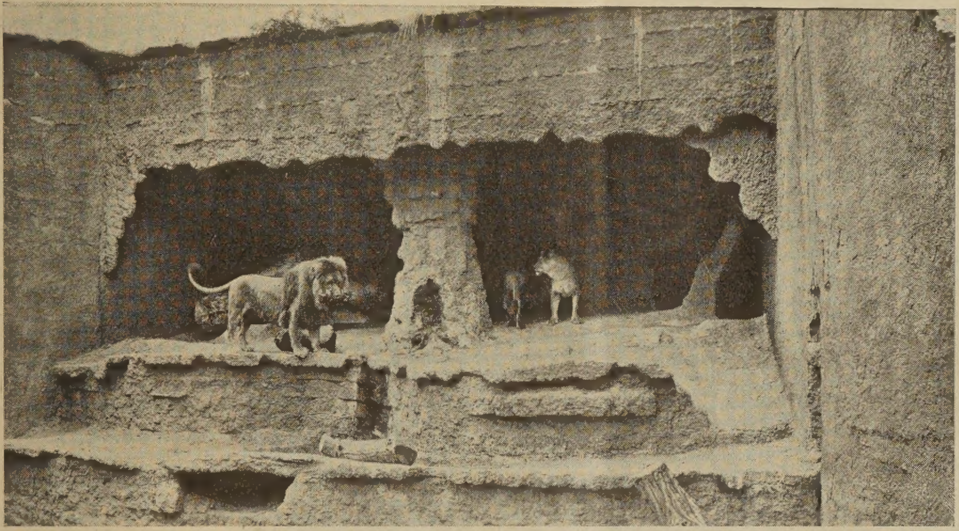


Fig. 3—Terraces and Cavern

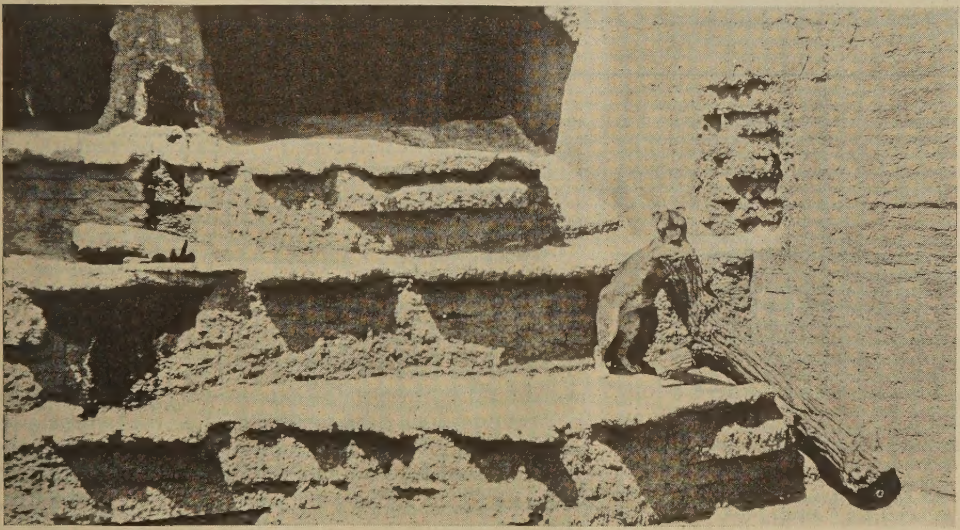


Fig. 13—Lioness on Terrace (Photo by E. Cooper)

the open Grotto are operated from a point entirely outside of the Grotto, and the doors, as well as the animals themselves, are at all times visible from the stations where the door levers are operated. The doors are of steel grating, hung on roller bearings at both top and bottom, and operate by swivelled levers run through heavy pipe filled with cup grease, so that though very heavy, they may be swung into place literally with one finger. The terraces of the main Grotto cover three complete drainage systems and every part of the structure is perfectly drained at all times (Figs. 3 and 8). Drinking water for the lions

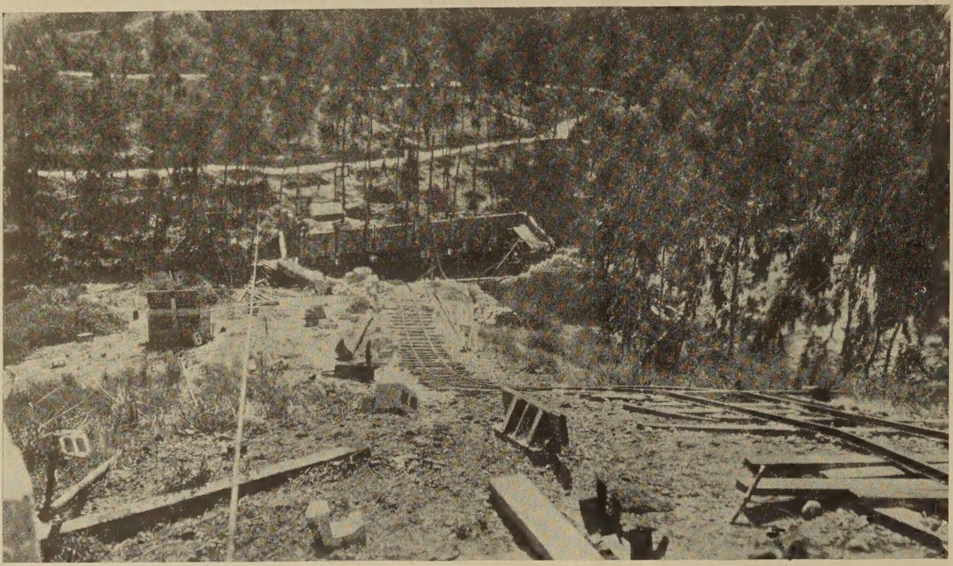


Fig. 10—Track over Which Materials Came from Hill Top to Bottom of Canyon

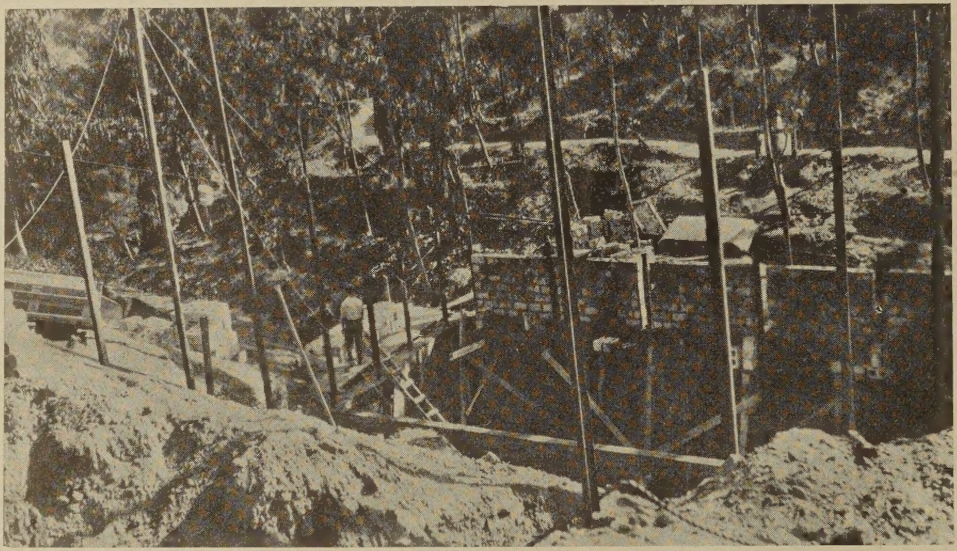


Fig. 12—Railroad Rails Placed Vertically in Side Walls for Added Strength

comes out of the huge main column supporting the rail-reinforced concrete roof over the cavern. The continuous flow of water trickles down into drinking pools in the terraces, the excess water being drawn off into the drainage system.

As in all of its important construction, the San Diego Zoological Society specified that reinforced concrete and concrete blocks should be used in the Lion Grotto. Steel rails, donated by the San Diego Electric Railway when new trackage was laid, were used for reinforcing, particularly in supporting the cavern roof where a long span bears enormous weight (Fig. 9). To carry out the ideas of the Directors of the Zoo, this Lion Grotto was built on one side of the canyon near the bottom, so that near the roadway in the bottom, visitors could look up the hillside into the Grotto. This necessitated some interesting construction problems, as the concrete materials, concrete blocks, railroad rails, etc., all had to be sent down the hillside with a small railroad truck and hoist (Fig. 10). Walls for the structure are of 8 x 8 x 16 Ideal concrete blocks (Fig. 11), these walls being strengthened by railroad rails placed vertically at frequent intervals firmly embedded in concrete in the ground (Fig. 12).

The president of the San Diego Zoological Society is Dr. Harry M. Wegeforth, whose zeal, enthusiasm and foresight have been the underlying factors responsible for the creation of a wonderful zoological park. Dr. Wegeforth has the following to say of the Lion Grotto:

"We have done just exactly everything that everyone told us not to do, and have done it in just the way they told us not to do it, and we believe we have the greatest Lion Grotto in America. We were told that the cageless type of animal quarters was not good; that we should build our Grotto on a hilltop rather than in a canyon, and that concrete was the worst possible material for constructing animal quarters. A delighted public; healthy, satisfied animals, and greater efficiency and safety on the part of attendants are evidence that the unorthodox may sometimes be best.

"In ignoring precedent, we found ourselves in a quandary. We knew what we wanted, but couldn't tell it to an architect with sufficient clearness to enable him to provide workable plans and specifications. We wanted this structure to be rough, rugged and irregular, and to adapt itself as nearly as possible to the natural environment of the canyon and hillside. So, with only the vaguest of written plans, we employed a contractor and threw ourselves, in a measure, upon his mercy. It was our extreme good fortune to secure for this work the Bent Concrete Pipe Company. The experience, technical knowledge and interest in our problems shown by Harry B. Tellyer, manager of that company's San Diego district branch, were infinitely valuable to us. As the work progressed from day to day, we pointed out to Mr. Tellyer the results and effects we wanted to produce. It was up to him to devise the means for producing these effects. Sometimes we demanded the impossible; many of our ideas approached the unattainable, but our contractor's ingenuity never failed to meet the crisis, and our Grotto is just what we planned to have it."

Some idea of the size of this artificial lions' den can be had from the following data and list of materials going into the structure: 1,200 yds. excavation; 2,500 yds. fill; 250 bbls. cement; 6,000 8x8x16 Ideal blocks; 1,000 Duntile 4x4x12; 1,000 Stonetile 6x12x4; 150 tons 70-lb. steel rails; 150 yds. concrete; 11 steel doors; 1000 sq. yds. stucco; 500,4-in. drain tile; 120 days construction time, (completed May 8, 1923); cost, $7,000.

Viaduct Repaired With Gunite

Flue gases from passing locomotives caused the Kellogg street viaduct in Wichita, Kansas, to deteriorate in such a manner as to necessitate a complete overhauling at an expense of approximately $45,000. The viaduct, 2,000 ft. long, which carries the business traffic of the city over the railway yards, has been in use for the past seven years.

It is the opinion of the city engineer that the concrete surfacing was not heavy enough over the reinforcing steel to withstand the fuel gases and that the sulfur fumes from coal smoke united with the moisture on the concrete and formed sulfurous acid and then sulfuric acid. The action of the acids caused the concrete to crack and expose the steel reinforcement of the structure. In seven years time the surface concrete was cracked in innumerable places and the structure was undoubtedly being weakened. A portion of the concrete parapet is shown in Fig. 1.

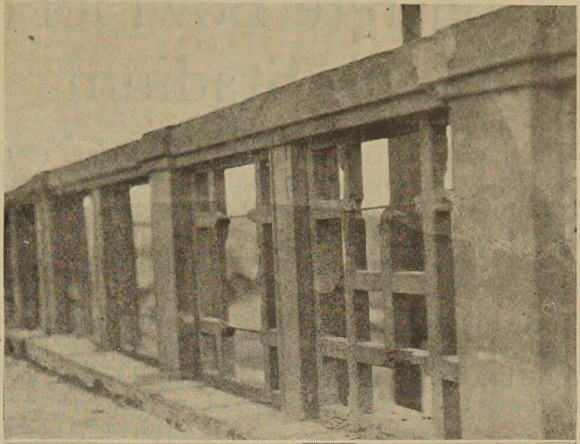
It was decided by engineers of the railways and the city that the viaduct had suffered no serious damage as yet, but that the action of the acids must be stopped. A contract was given to the Pratt-Thompson Co., Kansas City, Mo., to clean off the faulty concrete and coat the entire structure with a ½-in. covering of gunite.

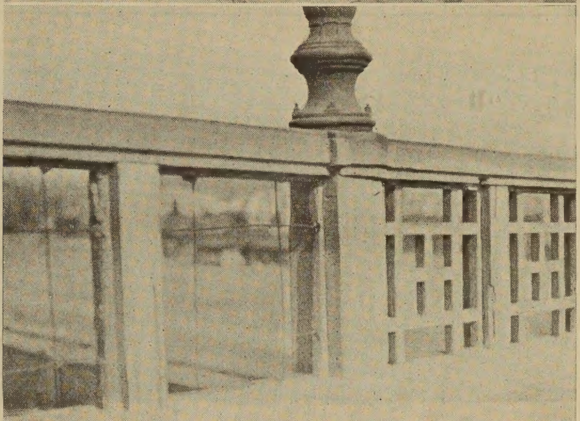
The work on the viaduct was handled by two men. They first knocked off all the loose concrete and then applied a sand blast to the exposed surfaces.

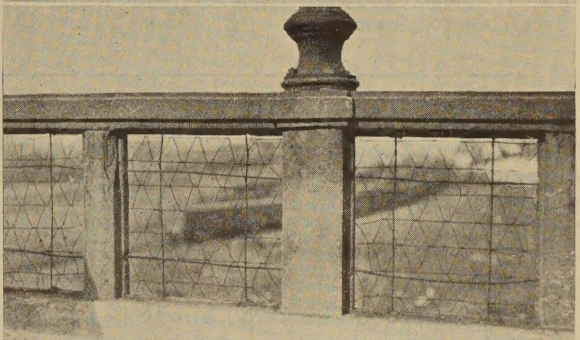
After the concrete of the parapet which showed signs of deterioration was removed, leaving the reinforcing rods exposed, a network of new reinforcing was added before the gunite was applied. This is shown in Fig. 3. Fig. 4 shows a section of the new parapet, a solid wall replacing the original open parapet, and illustrates the practical and artistic value of the work of the cement gun.

Panels were set the proper distance from the new reinforcing mesh. The railing was then shot 2 in. thick.

The entire structure was gone over, sand-blasted and cleaned, disintegration replaced and columns, beams, slabs and girders coated with gunite. The compressor equipment, consisting of two complete outfits, was located between the tracks below.







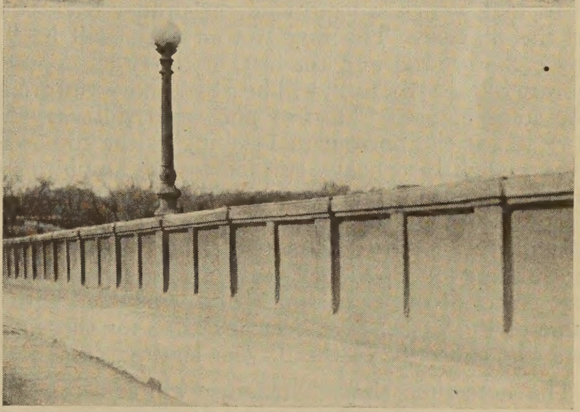


Fig. 1—Portion of Concrete Parapet to Viaduct Showing Effect of Locomotive Fumes

Fig. 2—Showing How Faulty Concrete Was Removed, Leaving Reinforcement

Fig. 3—Network Reinforcement Added Before Gunite Was Applied

Fig. 4—Section of the New Parapet

Concrete Bowl for Tennis Stadium

The increasing demand for permanent seating arrangements in one of the major summer sports has caused the West Side Tennis Club to erect at Forest Hills, L. I., the only structure of its kind in America and the second in the world, the other being constructed last year at Wimbledon, England.

These courts have been the scene of many National and International tennis tournaments. The amphitheatre has been rushed to completion to accommodate the crowds to see the 1923 Davis Cup matches.

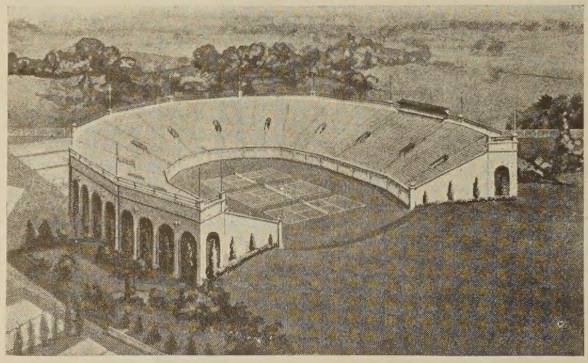


Fig. 1—America's Tennis Stadium—from a Drawing Before Construction

The enclosure, approximately oval in shape, will be 145 ft. in width and 195 ft. in length. Three courts with ample space between each will form the infield. Around this playing surface will be constructed approximately two-thirds of a concrete bowl with accommodations for 13,000 spectators. A general plan and details of construction are shown in Figs. 2 and 3.

The playing enclosure will be surrounded by a wall 10 ft. high which will provide the proper background for the players. The first row of seats will be 9 ft. above the ground and the last, or thirty-ninth row at the top of the structure, will be 51 ft. above the ground. The steps between the rows and seats will vary from 11½ in. at the bottom to 14½ in. at the top. This gives a slightly concave surface to the amphitheatre, enabling those in the rear to see clearly over the heads of spectators in the lower seats. Arrangements for leasing the priority rights to certain sections of the choice seats for a period of years have been worked out. Seat plates of non-corroding metal, embossed with the name of the lessee, have been installed for those members who subscribe to the 10-year leasing plan.

The horseshoe shaped structure will consist of what are commonly referred to as the north, south and west stands, leaving the east to the rays of the afternoon sun. The first row of seats in the north and south stands will be 75 ft. from the center of the middle court, while the topmost tier will be 165 ft. distant. In the west section of the stadium, the first row will be 95 ft. from the center court, while the thirty-ninth row will be 185 ft. away. When in time to come it is necessary to complete the bowl by the erection of the east segment, thus increasing the stadium capacity to about 21,000, the distance of the east section seats will be the same as that in the west section.

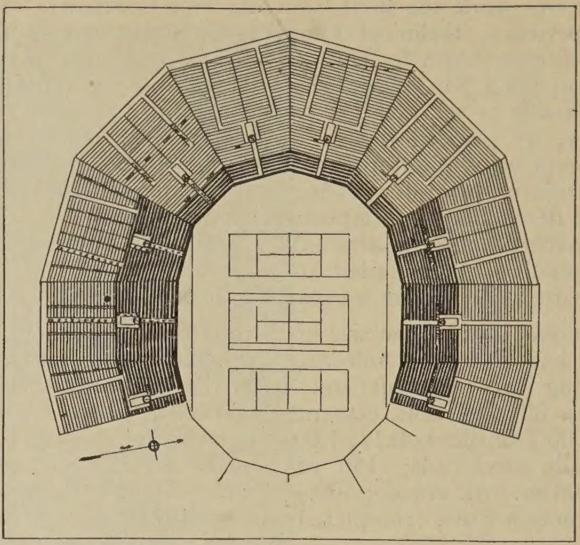
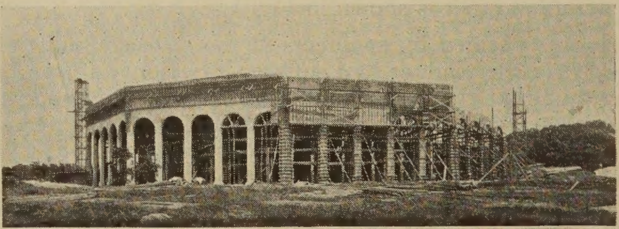
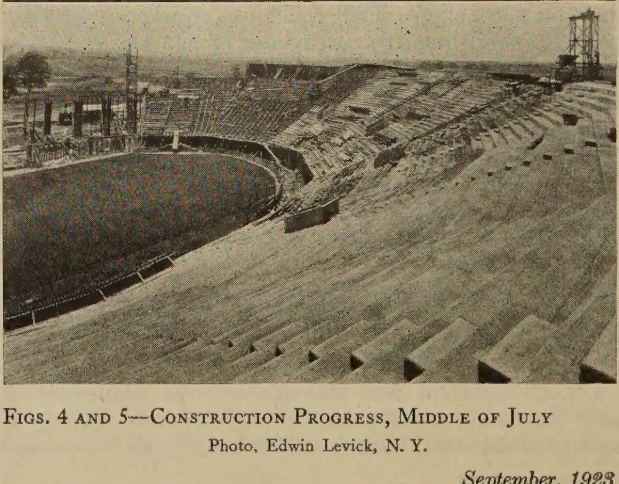


Fig. 2—General Plan of West Side Tennis Club Stadium

Construction of the championship courts is as follows. Former clay courts have been ploughed up and a subsurface drainage system installed. Twenty-four inches of top soil mixed with compost has been laid over this and carefully rolled and finished to uniform surface. Upon this will be placed sod to be taken from the present grass courts adjoining. The location of the new stadium has been fixed at about 650 ft. west of the present clubhouse in the southwest portion of the club property. The stadium will cover an area of approximately two acres or one-sixth of the club property.

Construction started early in April, and according to the contractors the stadium would be completed in four and a half months, or in ample time for the Davis Cup challenge round, which began August 31. July 19 the stadium was approximately three-quarters complete which seemed to assure its completion according to schedule notwithstanding a two weeks strike of the concrete workers. The work requires 5,000 bbls. of





Figs. 4 and 5—Construction Progress, Middle of July

Photo. Edwin Levick, N. Y.

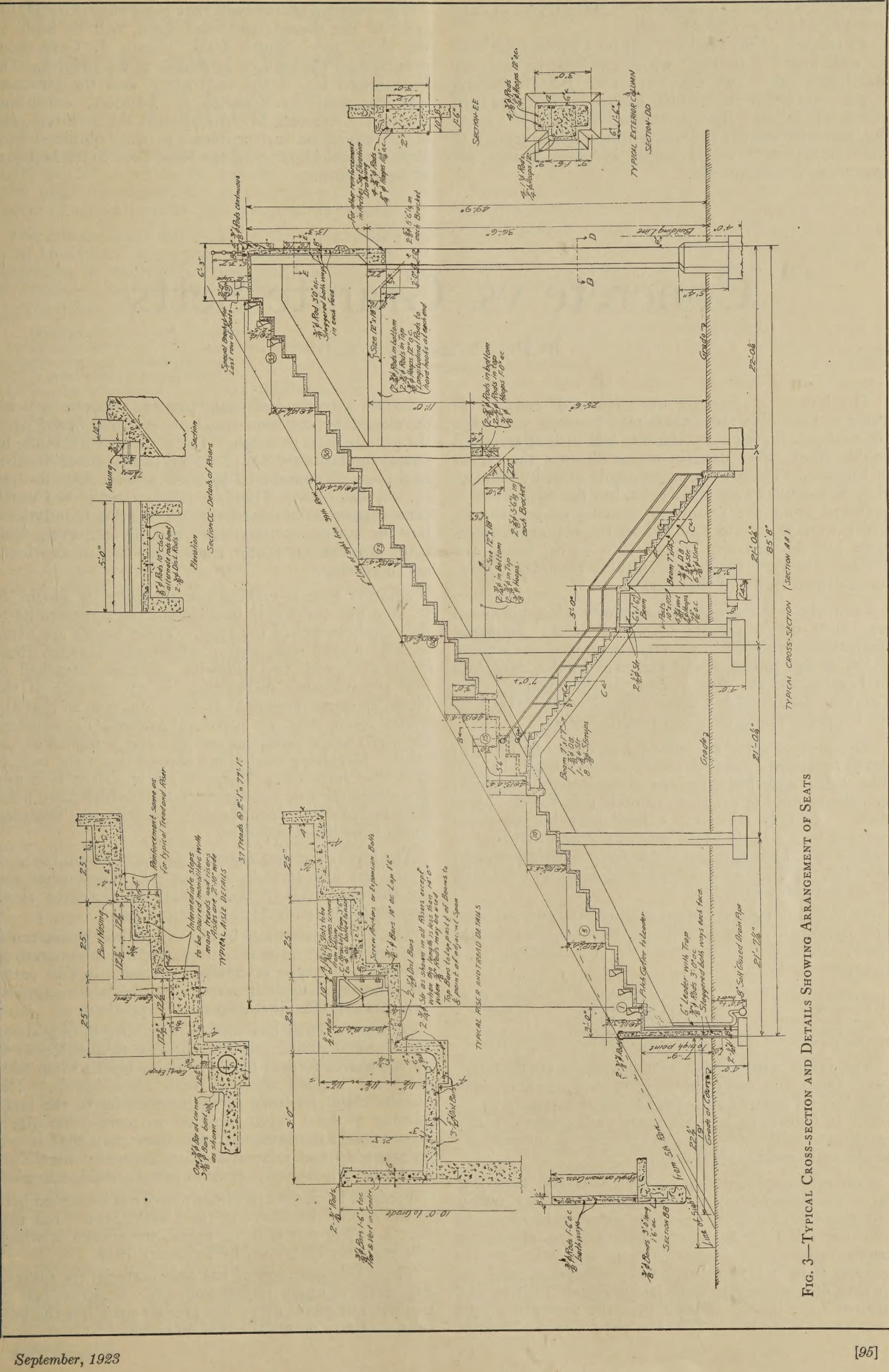


Fig. 3—Typical Cross-section and Details Showing Arrangement of Seats

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cement, 2,700 cu. yds. of gravel, 1,500 cu. yds. of sand and 175 tons of reinforcing steel.

At the top of the stadium will be a promenade four ft. wide and 715 ft. long, which can also be used for standing room. Ten stairways with portals leading to the seats will provide quick and convenient means of access and egress. The portals will have a 5-ft. opening, and with stairways leading to the under section of the stadium will afford ample accommodations for spectators in case of rain.

The stadium, which will cost more than $150,000 to erect in the present proposed form, will be built by the West Side Tennis Club. Louis J. Carruthers, president of the club, is in charge of the project. The Foundation Co. is the contractor, and the structure was designed by Charles S. Landers, consulting engineer. Kenneth M. Muchison is the architect, and expert advice on turf problems is being obtained from Prof. Samuel D. Gray of the New York State Institute of Agriculture.

Concrete vs. Granite Setts

By H. C. Badder, M. I. E. I.
London, England

The history of forming the surface of roads with stone is very old: more than two hundred years ago the first granite stone paving was laid in England, and cobble stones were used in towns all over the North of England. The granite was roughly axed by hand so that they could be set fairly even, but the cobble stones gathered from the mountain streams or sea shores, which were worn and rounded by the action of water, were just bedded and joined with earth, hence the surface was very rough but suitable for heavy, slow, horse-drawn traffic of that period.

Upon the introduction of machinery a large business was built up in granite blocks or setts. Immense quantities were used in pavements upon roads leading to docks and railways, and are, even at this date, laid in London for this heavy class of slow traffic. The Lambeth Council are buying them by the 1,000 tons for roads adjoining the great freight depots.

The granite setts are now made about 6½ in. in depth by 3½ in. in width and from 5 to 8 in. in length. The sides and bottoms are comparatively smooth, but the top is left rough to provide grip for the horse traffic. Usually laid over a hard core bed of stone covered with a half inch of sand, they were rammed or beaten to a bed, and the joints filled with fine gravel with hot pitch mixture poured in so as to fill the joints to make them waterproof.

At this date they are often laid over a concrete base, but the work is very costly as the following figures show, which are as reported by the Chester City Engineer for 1922.

	Type of Surface	Type of Foundation	Cost per sq. yd.
1.	Granite setts	7-in. Reinforced Concrete	$8.00
2.	4-in. Wood Blocks	7-in. Reinforced Concrete	7.00
3.	7-in. Reinforced Concrete	On Existing Foundation	4.00
4.	Concrete Setts	On Existing Foundation	3.00

The faults with granite sett pavement are that it is very rough and noisy under steel-tired vehicles, and very bad for heavy motor traffic, but this type of pavement is known to last 50 years under heavy traffic conditions with only occasional relaying where any settlement or subsidence occurs.

Concrete pavements have been laid and tested to meet the present day requirements for motor traffic, but the delays caused by using concrete in situ, and allowing full time for curing before being opened to traffic causes such disorganization, especially in city streets, that it is not favored by engineers, and the quality of the concrete work laid under difficulties, and against time limits, is such that the strength of the concrete is often below 1500 lbs. per sq. in. at 28 days.

Lately a method of using precast concrete is being developed by concrete engineering firms, based upon the granite setts principle. The concrete setts made by one of the firms are 8 x 12 x 5 in. thick, made die true in shape and guaranteed to crush at over 3000 lbs. per sq. in., when laid. They are bedded and joined in the same manner as granite setts over existing foundations, but the surface is practically smooth and even, thus being suitable for motor traffic, in which heavy loads are increasing.

Another firm is making precast units in blocks 10 ft. long but varying in breadth and depth according to the requirements of the road. These blocks are fitted with four steel rods, two of which pass through them lengthwise and two sidewise. Sleeves, attached to four counter-sunk metal rings in the surface of the block, engaged these rods at their junction, so that the whole block may be lifted or lowered by a crane. Each rod has a thread at one end and is butted at the other. Revolving bushes are slipped down the rods to meet the butt ends, where a screw socket is firmly fitted into the free ends of the bushes which have holes for a bar to make them revolve, to engage the threaded ends of the block opposite.

The blocks are thus drawn together easily and securely and are just as easily disengaged. The bushes and the threaded ends of the rods are protected by short iron pipes and embedded in the concrete.

The firm claims these blocks can be laid in one-tenth of the time and have four times the life of concrete in situ, and any type of finished surface, such as setts, wood block, or asphalt carpet, may be laid or applied immediately after the blocks are in position.

Another system provides circular disc blocks about two feet in diameter and 6 in. thick, with filler blocks to fill the spaces formed by the circular blocks when laid; these are bonded together with steel dowels. The makers claim the road is resilient owing to the large number of discs keyed together so there is no direct line of joint, the latter being a wave, and that it can be taken up and relayed at little expense; the joints are filled with asphalt, grout or other suitable material.

Vitrified brick for a pavement have not been used here to the extent they have in the United States, but this year a public test is being made, the results of which will probably be known by February 1924.

The whole question of the best material for present day traffic is under review and test. Concrete laid in situ will not go far here, but precast work has the best chance of any material based on results and cost.

Good Mortar, Mortar Joints and Mortar Colors

A question received as to how to produce a good black mortar in which to lay up concrete building units prompts suggestions as to good practice as to mortar in general, mortar joints and mortar colors.

The mortar itself should be of the right quality so as to be dense. A porous, weak mortar permits the absorption of water which frequently brings out the efflorescence that destroys the effect of the coloring. The essentials of good mortar are:

1. It should be dense and non-absorbent.
2. It must have a sufficient compressive strength to withstand pressure in the wall without crushing.
3. It must attain strength rapidly.
4. It must be reasonable in cost and easily obtainable.
5. It must possess good working qualities.
6. It should look well.
7. It should endure permanently.

The ingredients of portland cement mortar are portland cement, sand and water, and usually a limited amount of hydrated lime. There is a wide variation in the ratios of cement and sand used in making mortar. Some prefer as rich a mixture as equal parts of cement and sand, while others use a mortar containing three times as much sand as cement. A proportion of one sack of cement to 2 cu. ft. of sand will be found satisfactory under most conditions. A mixture containing an excess of 3 cu. ft. of sand for each sack of cement is not recommended. Hydrated or slaked lime may be added to the mortar in an amount not to exceed 25% by volume of the amount of cement in the mixture. This would be equal to about 12½% by weight. A common percentage is to use 10 lbs. of hydrated lime to a 100-lb. sack of cement Ten pounds of lime about equal in bulk twice that weight of portland cement.

The sands for mortar should be hard, clean and free from vegetable matter and contain not to exceed 7% by volume of clay or loam. It should be well graded from fine up to particles which will just pass through a screen having 4 meshes to the linear inch. Most masons prefer that the coarse particles predominate, making a more workable mortar. Usually any water which is fit to drink will be found satisfactory for making mortar. The mixing should be carefully done. The cement and sand should first be mixed dry to a uniform color, hydrated lime being put in at the same time. When lime putty (slaked lime) is used instead of dry hydrated lime it is customary to dissolve the putty to a creamy consistency in water and then use this lime water when mixing the mortar. Mortar should never be mixed in batches larger than can be used in 30 minutes. Mortar which has stiffened must not be remixed with water to impart to it workable qualities. Retempering is bad practice with portland cement mortar.

For high class work, the natural cement colors have been preferred to colored mortars. Only finely ground mineral coloring pigments should be used, as other pigments fade rapidly and reduce the strength of the cement to a marked degree. It is unfortunate that there are no reliable test data now available to cover this subject in detail. Mineral colors vary in quality, but from our present knowledge of the methods of using them, they show a tendency to fade depending on their quality. A color reground with the cement is to be preferred to a job mixed color.

Mineral coloring materials, due to their expensiveness are seldom used in mass concrete. The amount of coloring materials added should not exceed 10 % by weight of the cement, as larger quantities will reduce the strength of the mortar or concrete to an injurious degree. Ten per cent of most colors will produce deep shades which are intensified when white cement is used. Different shades of color can be secured by varying the amount of coloring material used or by mixing together two or more colors.

Prices of mineral coloring materials vary widely but are approximately as follows: Red oxide 3½ to 17 cents a pound; yellow oxides 5 to 20 cents a pound; black oxides 6 to 14 cents a pound; browns, buffs, and purples 3½ to 16 cents a pound; green oxides about $1 a pound and blues from 30 to 40 cents a pound.

Red oxides of iron produce the most permanent red tints. Venetian red should be avoided as it tends to run and fade. Manganese oxide is probably the best material for black, although a high grade of lamp black or carbon black is generally satisfactory. Common lamp black should not be used.

The intensities of shades produced by mineral colors will be slightly increased if the materials are mixed for a longer time than required for ordinary work. It has also been suggested that an application of a solution of magnesium fluosilicate or sodium silicate may be effective in setting the color in the concrete and checking a tendency of the color to fade.

Great care should be taken that successive batches of mortar contain exactly the same proportions of cement, sand, coloring matter and water, otherwise the finish color will not be uniform.

The mortar joints should be no thicker than required for proper bedding of the concrete units. Contact of the block in bed joints is not advisable, as the shrinkage of the mortar may leave them bearing only on the projections. A ⅜-in. joint is recommended for both horizontal and vertical joints in units 24 in. long and ¼-in. joints for units 16 in. long or less, in concrete block. With concrete units it is possible to use a thinner mortar joint than with most burned clay units due to the fact that the concrete units are likely to run truer to form, having no warp.

A good bond between the mortar and the block is essential. Block should be moistened and the mortar should be applied with force. Both ends of the block should be buttered. The horizontal or supporting section of the block should be entirely covered with mortar. Quite a number of styles of joints are in common use.

The flush joint is made by striking the mortar off flush with the wall surface. This is widely used when block are to be covered with stucco.

The struck joint is made by drawing the trowel along the joint with the blade resting either on the edge of the block below the joint, on on the edge of the block above the joint. The latter is preferable because it provides a more nearly weather-proof joint. This is sometimes called a weather joint.

The concave joint is made by drawing a pointing tool along the joint producing a concave surface. This operation compacts the mortar producing a dense watertight joint. It is the type of joint recommended as most practical for concrete block houses which are not intended to receive a stucco finish.

The tuck point joint is seldom used and is not recommended. This is formed by a special tool producing a joint which projects beyond the wall surface.

The Spanish Cement Tile Industry

By Frank Anderson Henry
United States Consul, Barcelona, Spain

From a special circular (No. 80) of the Iron and Steel Division of the Bureau of Foreign and Domestic Commerce.

The employment of tiles is universal in Spanish construction. There are many kinds and qualities for varying purposes. Some are highly ornamental and are arranged to produce artistic and pleasing effects while others are designed for strictly practical purposes. Their greatest utilization is for flooring, as wood floors are almost unknown in the average house in southern or eastern Spain. Tiles for flooring were introduced into Spain from oriental sources in the 12th Century since which time there has been a continuous development of their use. The Catalonia, Valencia and Western Andalusia regions are at present the most important centers of tile manufacture.

The manufacture of the modern concrete tile (Baldosas hidraulicas y Mosaicos hidraulicos) is a relatively new industry which has been hardly 50 years in existence and has reached its principal development in Barcelona where there are a number of important factories. At present, concrete tiles with mosaic patterns are used in practically all modern dwellings while those of a uniform gray color are to be seen on the side walks of cities and furnish the floors for warehouses and factories. The present production of Spanish factories is now calculated at more than 300,000 square meters of concrete tile annually. The industry, which is suitable for warm countries where natural cement is available at a reasonable price, is a simple one and gives under favorable circumstances, very satisfactory profits. Even where natural cement is not to be had, more or less slow setting cement mixed with common lime can be used. In either case the hardness of the product is all that can be desired. The face of the tiles should however be made with natural cement of a good quality to insure sufficient hardness. Spain is well supplied with the necessary raw materials, which combined with the large demand for the product, have stimulated the growth of the industry.

DETAILS OF MANUFACTURE

The tiles are made in suitable molds and a great variety of ornamental patterns can be obtained if desired. In each mold flat strips of copper are placed in order to limit the colors. In each one of the compartments formed by the copper strips is placed the desired color in a layer of from 5 to 15 millimeters thickness. The bands are then withdrawn and the mold filled with natural cement and sand of the required formula. The surface of colored tiles is formed of two distinct parts: the background and the mosaic. The background consists of a layer of slight thickness, though greater than that of the colors. The bulk of the tile, i. e., the lower part when it is in position, is of a different composition, having 20 kilos of sand and 50 kilos of natural cement.

The upper part which constitutes the visible face of the piece is composed, when intended to be white, of 10 kilos of sand and 100 kilos of natural cement.

Any kind of sand suitable for making mortars can be used for the first mixture. That used in the second should be very white or pulverized marble.

The coloring materials usually used on account of their being the most economical in making the different uniform colored surfaces are indicated as follows:

Black	10 liters of lamp black. 10 liters of natural cement.
Rose	1 liter red ochre. 10 liters of natural cement.
Orange	1 liter red ochre. 2 liters yellow ochre. 10 liters of natural cement.
Red	3 liters red ochre. 10 litres natural cement.
Gray	1 liter lamp black. 10 liters natural cement.

For patterns and designs in finer colors which can be combined with the backgrounds, the following compositions are used:

Black	15 liters lamp black. 10 liters natural cement.
Vermillion	1 liter red lead. 15 liters natural cement.
Blue	1 liter mineral blue. 12 liters natural cement.
Chocolate	1.2 liter orange oxide of lead. 12 liters natural cement.

All mineral colors not acted on by lime can be used, but organic colors cannot be employed as these do not resist the decolorizing effect of lime.

The mixtures should be made perfectly dry, preferably on a concrete floor. The necessary water is then added and the whole placed in a mixer of any one of the well known systems. After leaving the mixer, the compositions pass through a screen of more or less fine mesh according to their character. They are then placed in boxes mounted on wheels containing the necessary divisions to keep the colors separate. These are brought on rails to the center of the pressing room where an operator fills the mold and feeds it to the press. The mold is filled in the following order: first, the fine part to a thickness of 10 or 12 millimeters and then the ordinary part comprising the remainder. The tiles have four or six sides according to the shape of the mold but are one united piece.

When it is a question of making a tile with patterns the operation is begun by arranging at the bottom of the mold the series of metallic strips which compose the pattern and then filling with colored paste each of the spaces and intermediate compartments, then withdrawing the strips and filling to a certain height with the fine white paste or gray which forms the surface and finally filling the mold with the ordinary part which forms the bulk of the tile. After the molds are filled they are passed to the presses and from thence to the curing rooms, which should be moist, so that the hardening may continue for some time. It should last two or three months. After fifteen days they are sufficiently hard to transport with care but the maximum hardness is not reached until after two months.

The presses used are of three classes, hand, mechanical and hydraulic. It is essential that the mold receive the pressure when in an inverted position. For working on a small scale, a press of alternating movement is sufficient but important factories should be equipped with presses having a rotary movement. The presses of alternating movement consist of a plate which moves in a horizontal, rectilinear direction. They have two large mold carriers which alternately come under the action of the press while the other is being emptied and charged anew. Presses of rotary movement work on a vertical axle and a horizontal circular plate. They have a platform with 8 to 12 spaces for molds and have at the same time one in the press, one leaving automatically, and six or ten remaining so that the workmen have sufficient time to withdraw the pressed mold and place the recently charged ones. The construction of the presses varies with each factory but they consist essentially of a support, platform and press movement. The mechanism of movement and pressing ought to fulfill two objects, to exercise a gradual pressure on the tile, and to withdraw the mold from the platform. The hand presses are suitable for very small industries, and consist of a lever or screw, and flywheel. The tiles are subjected to a pressure of 80,000 to 100,000 kilograms which gives the maximum degree of hardness.

Presses moved by steam can be operated by mechanical or hydraulic transmission. This last system is most used today and has reached a state of perfection which leaves little to be desired. A well arranged factory consists of a steam engine which pumps the water to an accumulator from which the pressure is conveyed by means of a tube to all the presses. Opening the entrance valve for the water makes the press function automatically leaving the workmen only the task of bringing up and placing the filled molds.

The factories producing the tiles also make a great variety of articles, using natural and portland cement as raw material. One specialty very much in demand at present for construction purposes is artificial stone.

PRICES, SPECIFICATIONS, PLACING OF TILES

Prices of these tiles, net cash at the factory according to a recent price list of one of the leading manufacturers, vary from 10 to 15 pesetas and with exceptional qualities up to 20 pesetas per square meter, cost of boxing not included. Prices are approximately double what they were in 1915. The weight per square meter usually varies from 40 to 60 kilograms. A square meter consists of 25 tiles 20 centimeters square, which is the most common size, and the most usual thickness of the tiles is 35 millimeters.

The best mortar for placing the tiles is composed of slow setting cement and sand. For joining the tiles portland cement is best. For preservation and cleaning they should be washed with water containing dissolved soap but never with hydrochloric acid or corrosive liquids. Turpentine and wax will bring out the colors.

A certain small export trade in tiles exists and they are known to be shipped to Argentina, Morocco, the Canary Islands, and other countries but such shipments are insignificant compared to the consumption in Spain itself.

Material Dealer Furnishes Concrete Ready Mixed

Concrete ready mixed for the small contractor is the new service that is being furnished by R. McCalman, of Danville, Ill. He is a contractor and supply dealer, and he found that in order to handle his own work it would be necessary for him to have his own mixing plant. Then he figured a little further and decided that there were a number of contractors in Danville who would be glad of the chance to buy concrete ready mixed.

The principal units of his new plant are a large steel guyed derrick, furnished by the Equipment Corporation of America; a Lidgerwood three-drum hoist with attached swinger and a 75-H. P. motor, a 1-yd. Blaw-Knox bucket, a Marsh-Capron 6-bag mixer.

This plant stands alongside the tracks of the C. & E. I. R. R. This makes it convenient for the derrick to unload the sand and gravel from the cars. The derrick also feeds the mixer and loads the trucks with raw materials for customers.

It has been found that both large and small contractors make use of this service. In this way they can operate without needing considerable expensive equipment, and furthermore thay can handle several jobs at the same time.

The derrick has a 110-ft. mast and a 90-ft. boom. With its use the different kinds of raw materials can be placed around it in a semicircle. Whenever cement is required from the warehouse, the derrick handles it in special buckets.

The mixing plant is about 20 ft. wide, 30 ft. long, and 30 ft. high. It is divided into three levels. Chutes convey the aggregates from the top to the second levels, where the proportioning is done.

The chief limitation to a central mixing plant of this type is the period before the concrete starts to harden. It has been found through tests that in certain cases after a 45-min. haul concrete arrived in perfect condition.

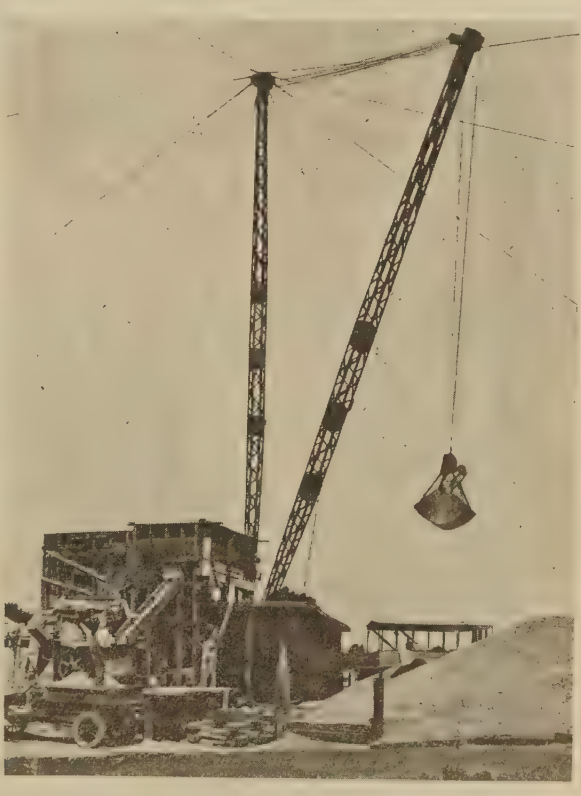

FIG. 1—MIXING PLANT FOR SUPPLYING CONTRACTORS WITH READY-MIXED CONCRETE

Significant Study of Concrete Poles by the Cleveland Railway Co.

By A. J. R. Curtis

Wooden poles for use in trolley and feeder line construction on electric railways seem doomed to early extinction. Rising initial costs, short life, high maintenance and growing scarcity are economic enemies which have already provided a big market for poles of steel and concrete.

With the wooden pole already dropping by the wayside, the struggle for supremacy in the future is likely to be between the steel pole and the concrete pole. Nearly twenty years ago the Cleveland Railway Co. discarded wooden poles for steel poles; ten years later concrete poles were introduced, and after a period of quite satisfactory use the company's engineers decided to make a careful study of poles made of the two in order to discover the relationships existing between their principal characteristics and develop comparative cost data.

The poles tested may be roughly classified into five divisions: (1) Solid concrete poles made by the company's maintenance organization (2) Solid concrete poles especially designed by the company's engineering department (3) Hollow concrete poles procured from a commercial concern (4) Heavy type steel poles and (5) Light type steel poles. Poles of the first classification had been in use for a number of years and samples tested were removed from locations on the street where they had been in service. The poles designed by the engineering department were constructed especially for the tests.

The specific objects of the investigation were (1) To compare concrete poles of the different types and sizes with steel poles of two commercial sizes then in use; (2) To determine whether the concrete poles then in use were of most economical design, and (3) To study the behavior of the concrete poles under various loads up to the point of failure.

Early poles, made by the company's maintenance department prior to the tests, measured 5 in. at the butt, and 25 ft. long, these dimensions being increased until at the time of the tests, the posts used in straight line construction had a 7-in. butt and 5-in. tip and were 28 ft. long. The earlier poles were reinforced with eight ⅝-in. sq. rods each having a length one foot shorter than the length of the post. Most of the poles now in use have six ¾-in. twisted square rods 27 ft. 6 in. long, 2 deformed ¾-in. rods 16 ft. long and one 1⅛-in. round bar 24 ft. long, which was placed in the center of the pole.

The experimental concrete poles designed by the engineering department were made 28 ft. long with 7-in. butts. The reinforcing consisted of a cage consisting of 8 spacer rings to which were wired four ⅝-in. deformed bars 27 ft. 6 in. long, between which were wired four ⅝-in. deformed bars 18 ft. long, as indicated in the accompanying illustration. The spacer rings were made from ¼-in. round stock in seven different diameters, corresponding to the taper in the posts. No. 12 gauge wrapping wire was then tightly placed spirally the entire length of the cage, the space between turns being about three inches.

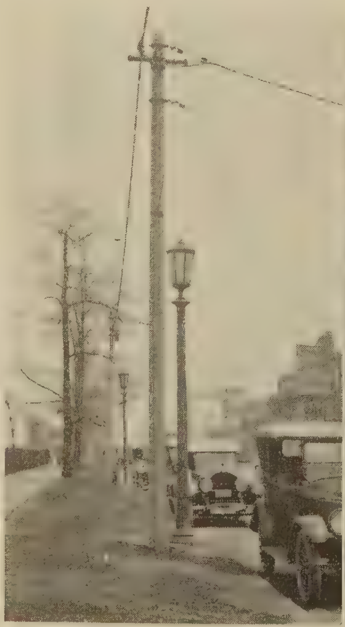

Fig. 1—(Left) Standard Concrete Pole in Use by Cleveland Railway Co.

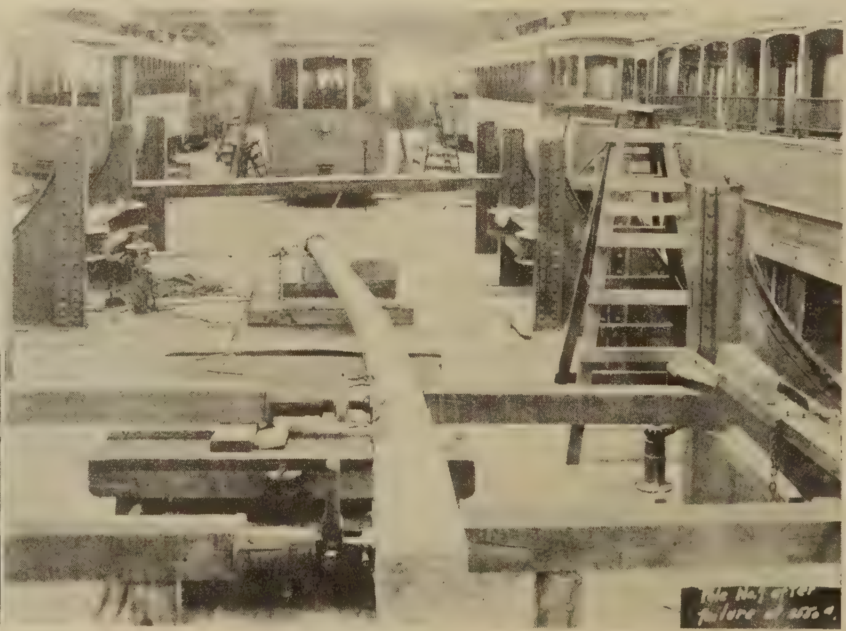

Fig. 2—(Right) Standard Concrete Pole Tested to Failure at Harvard Shops of Cleveland Railway Co.

The reinforcing for the experimental poles was designed to take care of an assumed load of 1000 lbs. consisting of about 820 lbs. horizontal pull of the span, 49 lbs. wind load on the trolley wire, and 135 lbs. wind load on the one million circular mill feeder cable. While the poles now in use are made of a concrete mix in the proportion of one sack cement to 2.1 cu. ft. sand and 1.3 parts pebbles, the experimental poles were made of the same materials mixed in the proportion of 1 part cement to 1.9 parts sand and 2.3 parts pebbles. This mixture was selected by reference to the tables prepared by the Lewis Institute Structural Materials Research Laboratory, in which it is indicated as capable of developing a strength of 3000 lbs. per sq. in. Test cylinders of these two mixes developed average strengths of 2370 lbs. and 3690 lbs. respectively, at the end of 28 days.

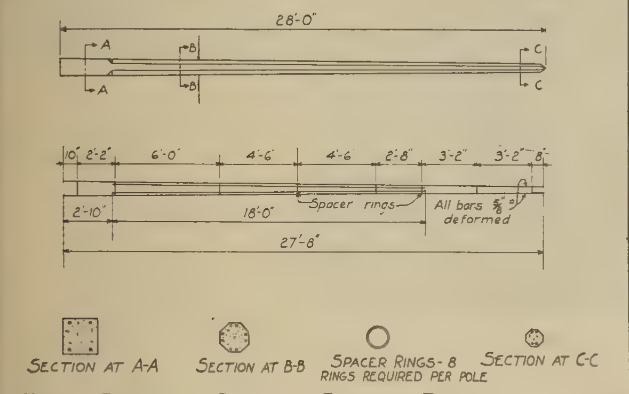

FIG. 3—DETAILS OF STANDARD CONCRETE POLE

Only two samples of the commercial hollow spun poles were submitted for test and unfortunately both of these proved defective due to thin walls supposedly caused by failure of the workman to place enough concrete within the forms. In fairness to the manufacturer, who is submitting duplicates, results on the spun poles are not reported.

The lighter size steel pole weighed 850 lbs. and had a length of 28 ft. and a diameter tapering from 7 in. to 5 in. The heavier type weighed 1375 lbs. and had a length of 30 ft. and diameter tapering from 8 in. to 6 in.

METHOD OF TESTING

A convenient method of testing was found involving the use of the stanchions used in straightening cars, to which the butts of the poles were blocked. This blocking was done by means of 6x6 blocks and jack screws, as clearly shown in an accompanying view. One set of blocks was placed near the tip of the butt and the other at the ground line. The load was applied by means of a chain fall also secured to the stanchions. The chain was attached to the pole at a point 18 in. from the top. A 10,000-lb. dynamometer was then placed in the line of force, next to the pole. Deflection of the poles under load was read by means of a transit centered on the line of action of the pole in the original no-load position. A rule was placed at the zero point of the poles from which each definite load reading was observed.

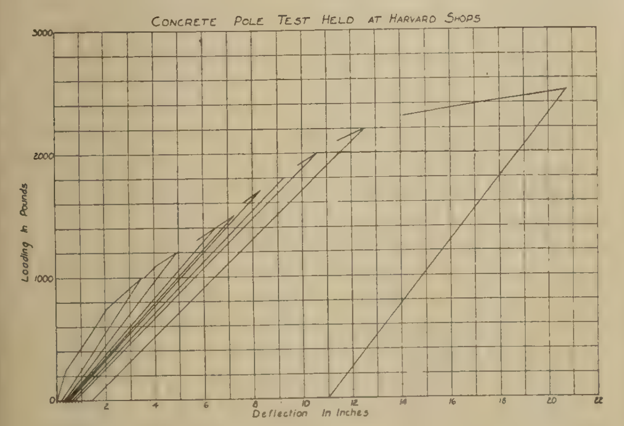

FIG. 4—RESULTS OF TEST OF CONCRETE POLE NO. 15 (TYPICAL)

The accompanying tables and chart present the results of these studies and show the relative costs of the concrete and the steel poles, as computed by the Cleveland Railway Co. Concrete poles have still further advantages, such as requiring no painting or maintenance.

CONCRETE POLE TEST HELD AT HARVARD SHOPS

New Pole (Pole No. 15-Typical) made with 1:1.9:2.3 mix and cage, at Windermere Yards, August 22, 1921.

Load	Deflection	Load	Deflection
250 lbs.	3/8"	1600 lbs.	7 5/8"
500 lbs.	1 1/4"	1700 lbs.	8 5/16"
750 lbs.	2 1/16"	0 lbs.	1/2"
1000 lbs.	3 1/2"	1800 lbs.	9 1/4"
0 lbs.	3/16"	0 lbs.	5/8"
1000 lbs.	3 5/8"	1900 lbs.	9 13/16"
1100 lbs.	4 1/8"	2000 lbs.	10 5/8"
1200 lbs.	4 15/16"	0 lbs.	3/4"
0 lbs.	5/16"	2100 lbs.	11 7/16"
1300 lbs.	5 3/4"	2200 lbs.	12 9/16"
1400 lbs.	6 1/2"	0 lbs.	1 7/16"
0 lbs.	3/8"	2300 lbs.	14 1/8"
1400 lbs.	6 1/2"	2400 lbs.	17 1/4"
1500 lbs.	7 1/4"	2500 lbs.	20 3/4" Failure
0 lbs.	7/16"	0 lbs.	11"

Small hair cracks appeared at 1800 lbs.

Failure on Compression Side, right at ground line, at 2500 lbs

COMPARATIVE LOADING AND DEFLECTION TESTS ON CONCRETE AND STEEL POLES

Description of Pole	Butt Dimension Inches	Ground Line Dimension Inches	Concrete Mixture	Reinforcing	Load Causing Failure Pounds	Deflection at Failure Inches
Old Type Concrete in service about 10 years	11x11	9 3/4x9 3/4		rods	2900	28 5/8
"	10 1/2x10 1/2	9 1/2x9 1/2		"	2900	26 3/4
"	10 1/2x10 1/2	9 1/2x9 1/2		"	2550	26 1/8
"	11x11	9 1/2x9 1/2		"	2400	27 5/8
"	10 1/2x11	9 1/2x9 1/2		"	3000	26 3/8
"	11x11	9 1/4x9 1/4		"	2550	21 1/4
"	11x11	9x9		"	2600	24 5/8
Present Concrete	12x12	....	1:2.1:1.3	"	2250	18
"	....	....	1:2.1:1.3	"	2260	*over 26 1/4
Experimental Concrete	11 1/2x11 1/2	9 5/8x9 5/8	1:2.1:1.3	cage	2700	23 3/8
"	11x11	10x10	1:2.1:1.3	"	2400	30
"	....	....	1:2.1:1.3	"	2500	21 1/4
"	....	....	1:2.1:1.3	"	2650	25 5/16
"	11x13	10x10	1:1.9:2.3	"	2600	*over 18 3/4
"	11x11	10x10	1:1.9:2.3	"	2400	*over 12 1/2
"	12x11	9 1/2x9 1/2	1:1.9:2.3	"	2600	20 1/4
"	....	....	1:1.9:2.3	"	2500	20 3/4
"	....	....	1:1.9:2.3	"	2000	*over 15 5/8
Steel	7" diam.	5" diam.	....	....	1950	21 1/4
"	7" diam.	5" diam. 9 with extra sleeve)			1950	17 3/4
"	8" diam.	6" diam.			3350	11 3/8
"	8" diam.	6" diam. (with extra sleeve)			3475	10 7/8

*Deflection could not be obtained at failure.

The word "rods" under the heading "reinforcing" indicates use of system in which longitudinal rods only were used.

The word "cage" under the heading "reinforcing" indicates use of system using spacer rings and spiral wire binding.

COMPARATIVE COSTS OF CONCRETE AND STEEL POLES

Type of Pole	Initial Cost	Cost of Digging Hole	Cost of Placing Pole	Cost of Installing Sleeve	Cost of Tamping	Cost of Painting Pole	TOTAL
Present concrete 1:2.1:1.3 mix, 12-in. butt, 28 ft. long reinforced with 6—3/4" twisted sq. 27′6″ long 2—3/4" deformed 16′ long 1—1 1/8" round 24′ long	21.00	$1.30	$0.23	—	$0.94	—	$23.47
Experimental Concrete Design, 1:1.9:2.3 mix, 12-in. butt, 28 ft. long reinforced with 4—5/8" deformed bars 27′6″ long 4—5/8" deformed bars 18′ long held by sight spacer rings and wrapped with No. 12 wire	15.90	1.30	.23	—	.94	—	18.37
Standard steel pole, 7" diameter at butt, 5" dia. at tip, with extra reinforcing sleeve	$44.00	2.20	2.60	14.07	1.04	.69	64.60
Extra heavy steel pole, 8" dia. at butt, 6" dia. at tip with extra reinforcing sleeve	77.00	2.20	3.40	14.07	1.04	.69	98.40

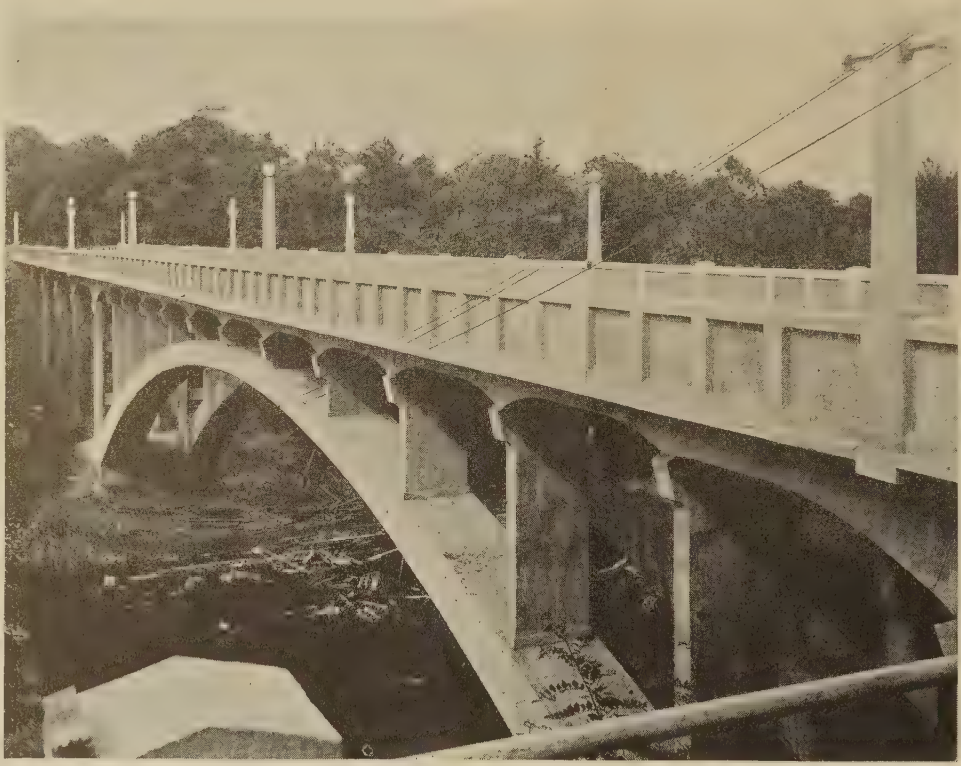

FIG. 1 — PERSPECTIVE VIEW—SHOWING ARCH AND GIRDERS IN DISTANCE SPANS, SALMON RIVER BRIDGE

Old Steel Arch Utilized in New Reinforced Concrete Structure

BY CHARLES F. BORNEFELD
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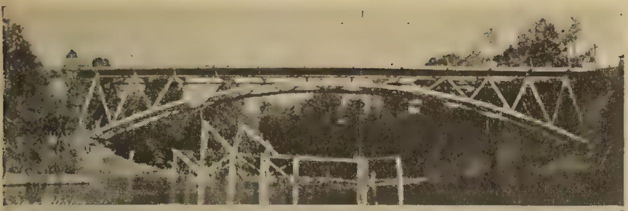
The new Salmon river bridge at Pulaski, N. Y., in Oswego county, crosses the Salmon river in the same location that the old steel structure has for the past 30 years, the old steel arch ribs having been incorporated into the new concrete ribs. This bridge carries Jefferson street over the river and valley, giving the shortest and most direct route from the center of the business district of the village of Pulaski to the New York Central Railroad passenger and freight depots, a distance of about a half mile.

The old steel structure consisted of a 216-ft. three-hinged arch with inclined spandrel posts and horizontal upper chord and two 72-ft. continuous trusses with an 18-ft. cantilever at each end. The two parallel arched chords spanned the river. The continuous trusses which were supported on three pairs of steel posts 16 ft. apart in the bent spanned the valley. The floor system consisted of 21-in. beams with cantilever attached for the sidewalk, and 7-in. I-beams for the roadway and 4-in. I-beams for the sidewalks. These stringers were 18 ft. long, the panel length. The whole structure was very light and very weakly connected stringers and floor beams being simply clipped together. Corrosion at these connections was very bad. The town had experienced continuous and costly maintenance on this structure up to the summer of 1922, when it was finally condemned as insufficient to carry the present day loads and closed to the public. However, the metal of the lower chords was sound except at the south pin connection to the abutment which was at least 50% corroded due to water dribbling and dripping directly on these important connections from the overhanging rock structure above. The abutments as such were sound, the south end of the steel ribs abutting directly into the vertical rock structure through sound limestone masonry and the north ends being carried to rock ledge 6 ft. down through masonry laid in concrete.

The Town Board submitted a bonding proposition to the voters based on an estimated cost for an all concrete-steel structure to replace the old worn out steel bridge. The bond issue was successfully carried by the vote of the people for $54,000. By a special law in the County of Oswego, the towns are assisted in the financing of larger works by the county at large, which in this case bears one-third the estimated cost, or $26,000. The whole project was estimated to cost $80,000.

In consideration of the most feasible, as well as economical and practical, solution of the problem, the engineers made several studies comprising various arrangements of arch spans. As the village has another bridge crossing further up stream, it was considered not objectionable, though somewhat inconvenient to pedestrians, to close the structure entirely to traffic and not go to the added expense of erecting temporary crossing. The old bridge was therefore available as a working structure for building the new bridge. To



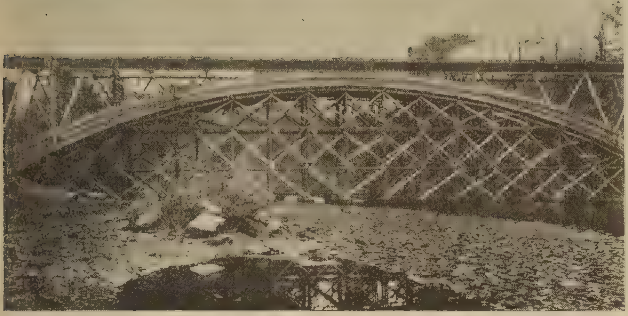


Fig. 2—Old Steel Arch Bridge—Centering Erection Begun

Fig. 3—Centering View—Ribs Cast. Transverse Wall Form Work Started

simplify erection costs, thereby reducing these costs, the design adopted was so proportioned that minimum interference between the old and the new structural parts was secured. The outstanding feature of the design is the incorporation of the old steel arch ribs into concrete arch ribs and the complete and efficient encasement of the old abutments into the new concrete abutments without disturbing the stability of the old abutments and still providing ample bearing to secure reasonable rock foundation pressures.

The design of the new structure comprises the following units:

Beginning at the south end with a small retaining wall on the top rock strata, the deck is carried by an 8-in. slab a span of 12 ft. to the south main abutment walls; thence north by two arch ribs of 200 ft. clear span supporting transverse walls 18 ft. on centers which in turn carry transverse girders into which beam and slab deck structure is cast, to the main north abutment. The arch ribs span the river, shore line to shore line. From the north abutment the bridge consists of a continuous series of four girder and slab spans of 34-ft. clear span. These girders are supported by tall column bents which are tied to footings 5 ft. wide and 23 ft. long. The abutments of the arch and all column bent footings and retaining walls were placed on solid limestone rock, the depths of excavation for the various foundations varying from 6 to 9 ft.

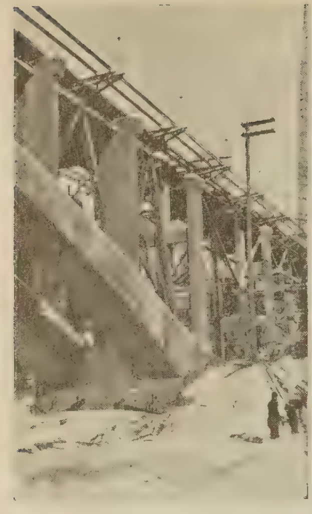
A fill connects the girder structure with the approaching roadway on the north. The entire length of the bridge including the fill is 455 ft. It is 32 ft. out to out of copings. A 20-ft. roadway and two 5-ft. sidewalks of cantilever type and 9-in. parapets occupy this width.

The arch ribs have a rise of 26.5 ft. on the 200 ft. between springing lines and the introdos curve is a three-centered arc. The extrodos curve is a two-centered arc. The crown thickness of each rib is 3 ft., the haunches at springing line are 5 ft. 6 in. thick on the radial section. The width of the ribs from the crown to the abutment increases from 5 ft. 4 in. to 7 ft. This increase follows parabolic curves symmetrical to the longitudinal centerlines of the ribs. The transverse walls, however, are uniformly 4 ft. 10 in. wide and 15 in. thick. Transverse girders are also 15 in. wide. The beams and slabs of the deck are continuous spans between transverse expansion joints, there being four series of three spans of 18 ft. per span. Expansion joints are located at the abutments, the crown and the quarter points of the arch. At these locations the transverse girders are set at a lower elevation than intermediate girders, so that beam ends would have a simple but effective horizontal plane on which to slide. The top surface of these expansion joint girders was finished smooth with a steel trowel and before casting the beams on this surface two layers of two-ply roofing paper were laid on the smooth surface. The sidewalk is a simple continuous cantilever section which is held by the outside beams and also tied through these beams to the adjacent slab, the curb portion of the section being part of the outside beam.

The arch ribs are designed for 150 lbs. per sq. ft. live load in addition to the actual dead loads. The ribs were also analyzed for the most disadvantageous position affecting critical sections of a 21-ton road roller. Maximum stresses were therefore found for a combination of the two live loadings here mentioned. For stresses due to temperature changes a variation of plus and minus 30° Fahrenheit was used. The modulus of elasticity for concrete was assumed at 3,000,000 lbs. per sq. in. A maximum stress of 750 lbs. per sq. in. was allowed for concrete in compression and all sections were so designed as to exclude concrete in tension. The increase of the width of the ribs from the crown to the springing lines was given full consideration in calculating the moments of inertia of the rib sections. The unit stress in the steel reinforcement was assumed at 11,000 lbs. per sq. in. This was purposely assumed low in order to keep concrete stresses within the limits taken. In distributing the steel area at the various cross sections, 90% of the section of the old lower chord was included at the crown and wherever else this old section could be used consistently to advantage. No allowance for rigidity of these embedded chord members was made, on account of the weakness of the pin connections.

The floor system over the arch was designed to carry concentrations from a 21-ton road roller with 20% impact. The unit intensities allowed were, for concrete, 650 lbs. per sq. in. compression, and 16,000 lbs. per sq. in. for steel reinforcement in tension.

The four approach spans on columns are designed as continuous girders and were analyzed for liveload of 150 lbs. per sq. ft. and for temperature changes of plus and minus 40°. Road roller concentrations of 21 tons were also analyzed. Unit stresses were kept below 650 lbs. per sq. in. compression in concrete and 16,000 for steel in tension. An interesting feature of this approach design is the rigid connections of the columns to the girders and the footings. The footings are so massive that the columns were considered as fixed at the base. Under these conditions the columns were so proportioned that they would take, in addition to the direct pressures, the bending resulting from the temperature changes as well as the bending due to loading conditions resulting from superimposed liveloads on certain spans with the remainder of the spans free of liveload. These bending moments in some cases are quite large and are reversible. Reinforcement in the columns is therefore symmetrical on both sides. Stresses allowed in these sections are low, as the great length of these columns required some body for stiffness. The girders are shaped with curved haunches on each end. This is an important feature of the design as the increasing stiffness thereby gained as columns are approached was taken advantage of. The consideration of this variable section materially decreased the maximum bending moments at the center of the spans thereby permitting minimum depths of sections at the center. While the bending moments over the columns are increased by this method, this becomes of special value, because deeper sections are



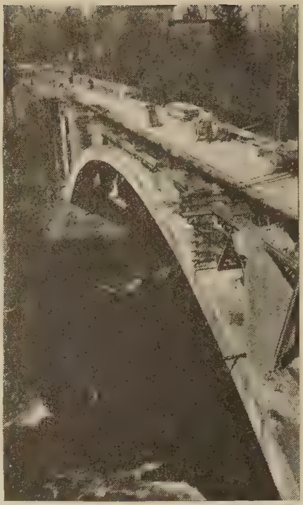


Fig. 4 (Left)—New Concrete Work—Walls and Columns, Erected without Disturbing Old Steel Bridge Supports

Fig. 5 (Right)—Concreting Deck and Sidewalk

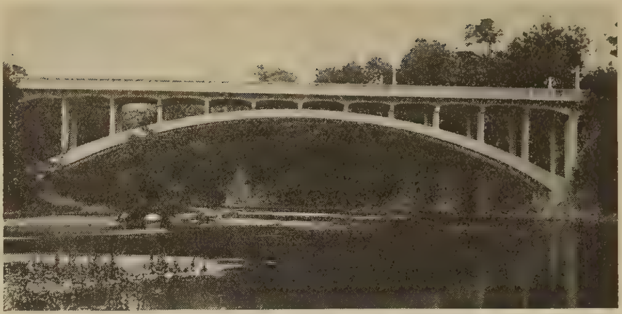


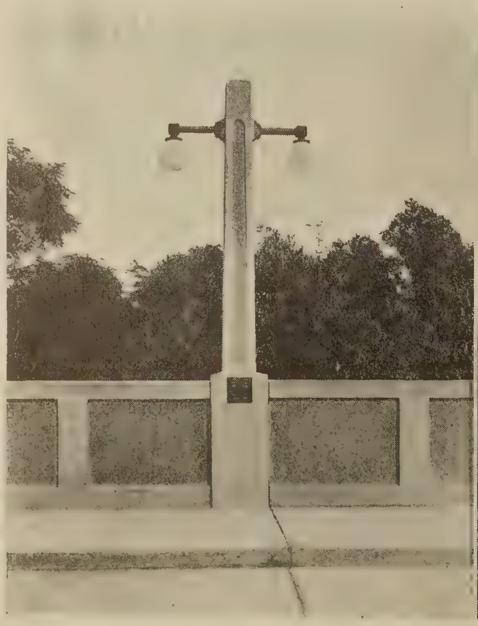
Fig. 6—Upstream View of Arch Rib Portion of Bridge

ordinarily needed anyway at the columns to reduce the shearing stress intensities.

The parapet wall is of plane rectangular design, with top hand rail, base and panels set off by vertical posts. The panels are 3 ft. 6 in. long and 2 ft. 9 in. high with a thickness of 2 ft. 6 in. These panels were cast off the job in a shed built for the purpose at the bridge site, so that they could be cast in the winter with steam heat protection. They are reinforced with heavy wire mesh. A surface treatment consisting of exposing the special lake shore gravel aggregate by carefully brushing the surface film of cement off and washing the resulting surfaces clean with water, before final setting of the concrete, was given to these panels. The effect after setting the panels in the parapet and casting the base, top and posts around them, is a pleasing contrast between the rubbed surfaces and the brushed surfaces both in color and texture.

Nothing unusual presented itself in the actual construction of the bridge. Testing of the various local sands led to the necessity of proportioning a coarse and fine sand to obtain a sand having the proper fineness modulus. Concrete cylinders were also tested before the work progressed very far in order to arrive at proper conclusions as to cement, aggregate and sand proportions. Centering for the arch ribs was constructed, as it was not considered safe to suspend the rib concrete from the old steel. This falsework consisted of vertical posts of 6-in. x 6-in. longleaf yellow pine, 8-in. x 10-in. caps, 3-in. x 12-in. joists and 1-in. lagging and the usual sway bracing. The river bottom is a gravel deposit with rock some 8 ft. below the bottom. To have driven piling in this material would have been impossible. The undisturbed river bottom was therefore tested by actual loading test. A 2-ft. x 2-ft. concrete pedestal was cast directly on the gravel through about a foot of quiet water and loaded after setting with steel. This bearing test showed that the undisturbed gravel bottom was safe for a loading of 1½ tons without any appreciable settlement. The contractor was therefore permitted to build footings for the centering posts, so proportioned as not to exceed this bearing load. Accordingly, concrete pedestals 2 ft. 6 in. wide and 9 ft. long were built for each bent of three posts. Subsequent observations on the crown settlement of the arch ribs after all concrete was placed showed less than a half inch deflection and this could be accounted for in the take up of the timber joints.

The deck of the old bridge served the contractor as a working platform, to which all rigging for erecting centering was attached, as well as a distributing platform for materials and the deposition of all the concrete. Plant equipment for this work was therefore a minimum



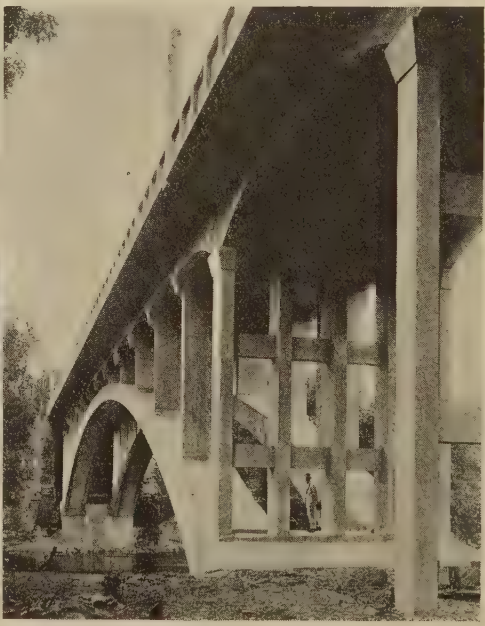


Fig. 7—(Left)—Lamp Post and Panels of Parapet

Fig. 8 (Right)—Lower Perspective, Showing Column Bents and Floor System

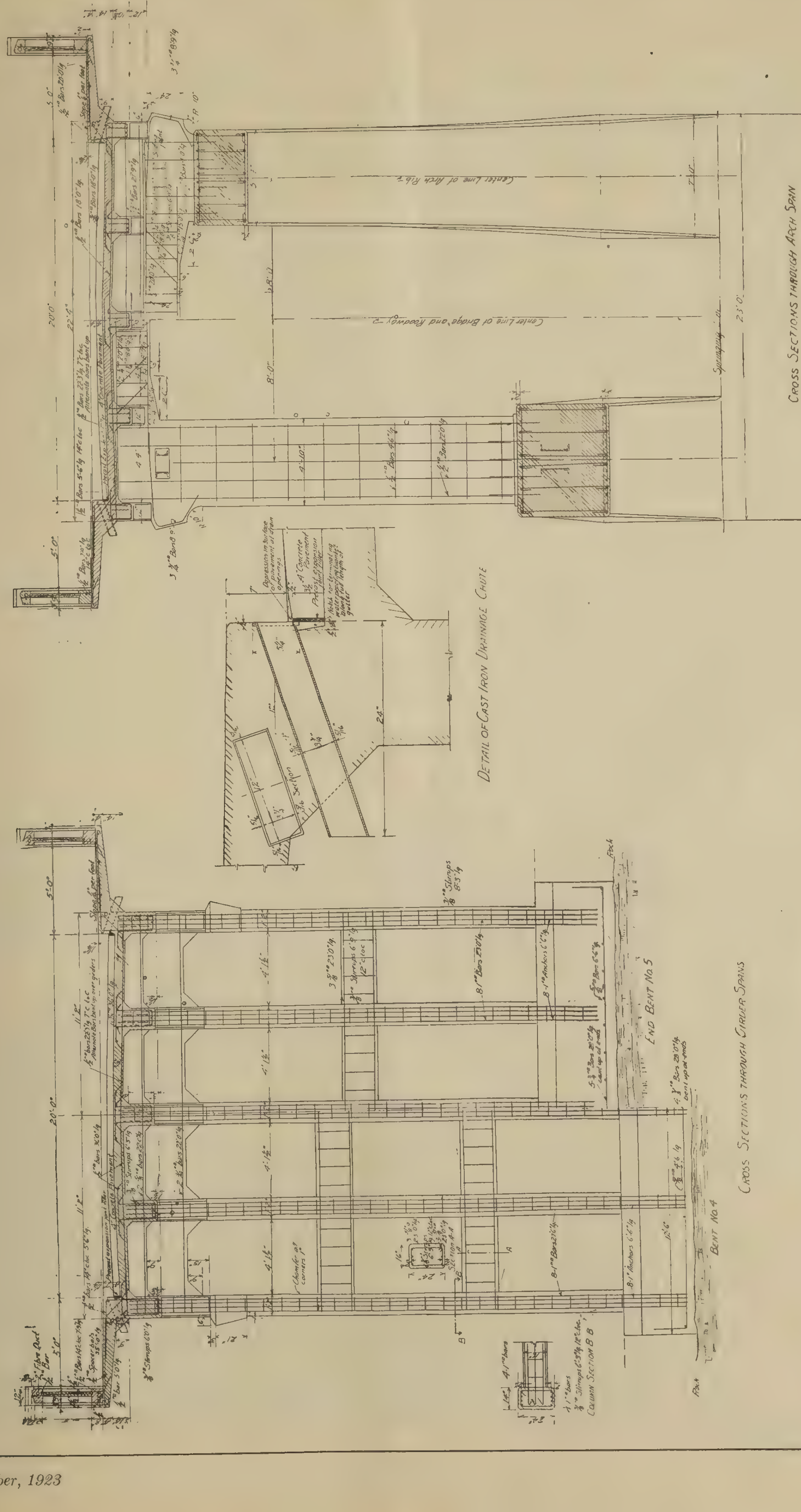

Cross Sections through Arch Span
Center Line of Arch Rib
Center Line of Bridge and Roadway
Springing
23'0"
20'0"
5'0"
8'0"
4'10"
Detail of Cast Iron Drainage Chute
24"
Section
Cross Sections through Girder Spans
End Bent No 5
Bent No 4
11'2"
4'1½"
Section A A
Column Section B B
Rock

Fig. 9—Sectional Details of Girder and Arch Spans

and consisted mainly of a ½-yd. mixer, a boiler and some concrete buggies. All concrete below the deck was deposited in the various sections by elephant chutes hung from the deck of the old bridge at various locations.

Contract for the work was made on September 1, 1922 and work started immediately. After the foundations and arch ribs, transverse walls and columns were in, the winter weather concluded outside activities about December 25th. Work was resumed again in March and prosecuted to completion in July. Falsework for the arch ribs was dismantled and used in different framing for the girder spans. Removal of the old deck was confined to sections between expansion joints of the new deck and progressed from section to section until the new deck entirely replaced the old.

The arch ribs were poured in sections of equal volume. Each rib was divided into three sections symmetrically located with respect to the crown, making six sections in all. Keyways were left at the crowns and the haunches. The order of pouring was as follows: crown sections, haunch sections, quarter point sections. Keys were closed in after several days elapsed after the pouring of the last main section and all four were cast at the same time. This program was specified to reduce as much as possible the effect of shrinkage.

Abutments, footings for columns and bents were poured as monolithic sections to springing lines and base of columns. Columns and struts of the girder spans were also poured without construction joints from the footings to the base of beams. Transverse walls were poured as continuous work from the arch ribs to base of beams. The floor system was continuous work between expansion joints. In cross section this included longitudinal beams, transverse girders, sidewalk cantilevers and curbing. The sidewalk finish of 1 in. of 1:2 cement mortar was placed immediately on completion of the sidewalk casting, before the concrete had initial set. All concrete was a 1:2:4 mix excepting of the major portions of the abutments and footings of the columns which was a 1:3:6 mix. Parapet panels were a 1:1½:3 mix. The top surface of the floor slab was waterproofed with a one-ply membrane of asphaltum and cotton fabric. This membrane was flashed up into a specially cast groove in the curb side a height of 4 in. On the top of this waterproofing a pavement or wearing surface of 4 in. of concrete of 1:1½:3 mix was laid to a parabolic pavement crown with a rise of 3 in. Drains are located every 35 ft. on both sides of the pavement at the curbs.

Five concrete lamppoles are located in the parapet wall on each side of the bridge. These are connected by conduit cast in the handrail of the parapet. Bronze lamp fixtures on the various poles provide 16 for the structure.

All the old steel members, tie rods, etc. which were partially encased in the ribs and the transverse walls, such as lateral struts, sway rods, lower ends of inclined web members and top chords, were burned off several inches back of the neat lines of the concrete with the oxy-acetylene flame burner. This was easily done as all these old members were boxed in by a small form. After burning off the old steel the recesses left were cleaned and neatly filled and patched with mortar.

The bridge was designed by the Concrete-Steel Engineering Co., William Mueser, sole owner, with E. H. Harder as assistant engineer in charge of design and the writer as resident engineer. The bridge was erected by G. W. Thompson, contractor and engineer, with A. E. Wynn, construction engineer; O. Matthys was superintendent for the contractor with M. Colle as carpenter foreman, the latter finishing the work as superintendent.

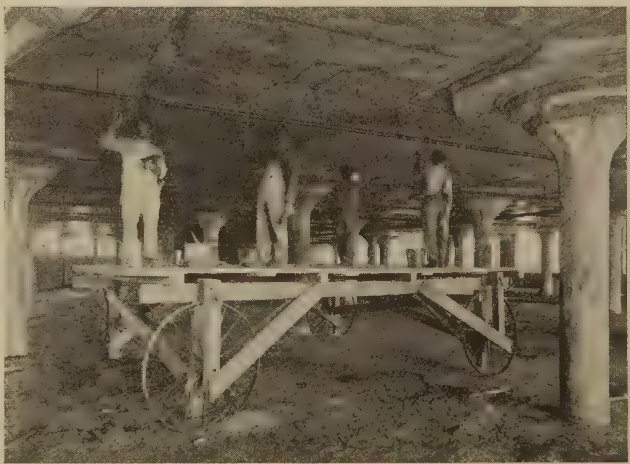
Minimum Floor Load Requirements in Building Codes

Efforts are being made by the Building Code Committee of the Department of Commerce to standardize building law requirements in the United States and to remove many existing congruities and aid in more efficient utilization of materials. As a part of the committee's study of allowable floor loads for different occupancies, it has prepared a table giving the floor load requirements as found in 109 city building codes, these cities being selected to fairly represent practice in all parts of the country. A summary of the table follows:

The work of the building code committee is for a very worthy cause and in view of the fact that the committee is entirely dependent upon such voluntary donations of data as can be obtained for use in its work, readers are urged to render any assistance they can to the committee by furnishing information to be used for public benefit. The summary shows quite clearly the wide variations and need for standardization.

Movable Staging for Overhead Work

In speeding up overhead work, it has been found through experience that movable platforms can play a highly important part. One of the foremen for the Aberthaw Construction Co., Boston, Mass., decided one day that he would try the experiment of mounting one of the big platforms on wheels and testing it out. He used for this purpose two sets of wheels borrowed from concrete buggies, and supported them on old form bolts driven through the platform posts. The framework used for this platform was made of joists formerly used for form lumber. The top was made from floor form panels. After the workmen had completed the strip of ceiling that they were busy with, they could move the platform forward by simply shoving against the ceiling with their hands.



The accompanying illustration shows the movable staging in use on the Decatur and Hopkins Co.'s warehouse job, Boston.

Unusual Structural Features Mark Grauman's Metropolitan Theatre

GRAUMAN'S METROPOLITAN THEATRE and office building, Los Angeles, Calif., was erected for the Hill Street Fireproof Building Co. For the building as a whole, the structure and exterior and the mechanical equipment in the office section, Edwin Bergstrom, Los Angeles, was architect. The concrete was designed by R. C. Mitchell, engineer for Edwin Bergstrom.

William Lee Woollett, Los Angeles, was architect for the theatre portion of the building, including its mechanical equipment. The treatment of the interior concrete of the theatre as designed by Mr. Woollett was described in CONCRETE for August, 1923.

The Winter Construction Co. was the general contractor and E. Ceriat was contractor directly under Mr. Woollett for the decorative concrete of the interior of the structure.

In Grauman's Metropolitan Theatre in Los Angeles, many unusual features in reinforced concrete construction were worked out with a boldness unprecedented in engineering. The structure includes what are, without doubt, the largest structural members ever built of reinforced concrete, these structural features being fully as interesting as the architectural treatment of the building as described in the August issue of CONCRETE.

The building of which the theatre forms a part is located on Hill and Sixth streets. It is 13 stories high and has a frontage on Hill street of 240 ft. and on Sixth of 155 ft. An alley extends along the east side of the building and a property line forms the northern boundary. The theatre, which extends to the height of 8 stories, is partly surmounted by 5 stories of offices.

Construction of the theatre section is of unusually heavy beam and girder type and a flat slab system was used in the office wings of the building. In the office wings, beams 16 in. deep and 20 in. wide supported by columns 20 in. square, carry the floor slab which has a finished thickness of 5½ in. from the ceiling to the floor. The floor slab is reinforced with two-way reinforcing. The clear ceiling height is 10 ft. 1 in.

The theatre occupies the greater part of the ground floor and comprises an auditorium 135 ft. x 127 ft. and a stage 45 ft. x 130 ft. The total seating capacity of the theatre is 3,900, about one-half of which is in the balcony.

The first 7 stories up to the roof include besides the theatre, 106 offices, extending back one tier on the Hill and Sixth street sides of the building and a row of shops 26 ft. deep. Above this height a U-shaped tier of offices 5 stories high extends around the north, east and south sides, with a depth of 50 ft. on the east and 48 ft. on the north and south sides. This portion of the building, which forms an open court on the Hill street side, contains 355 offices.

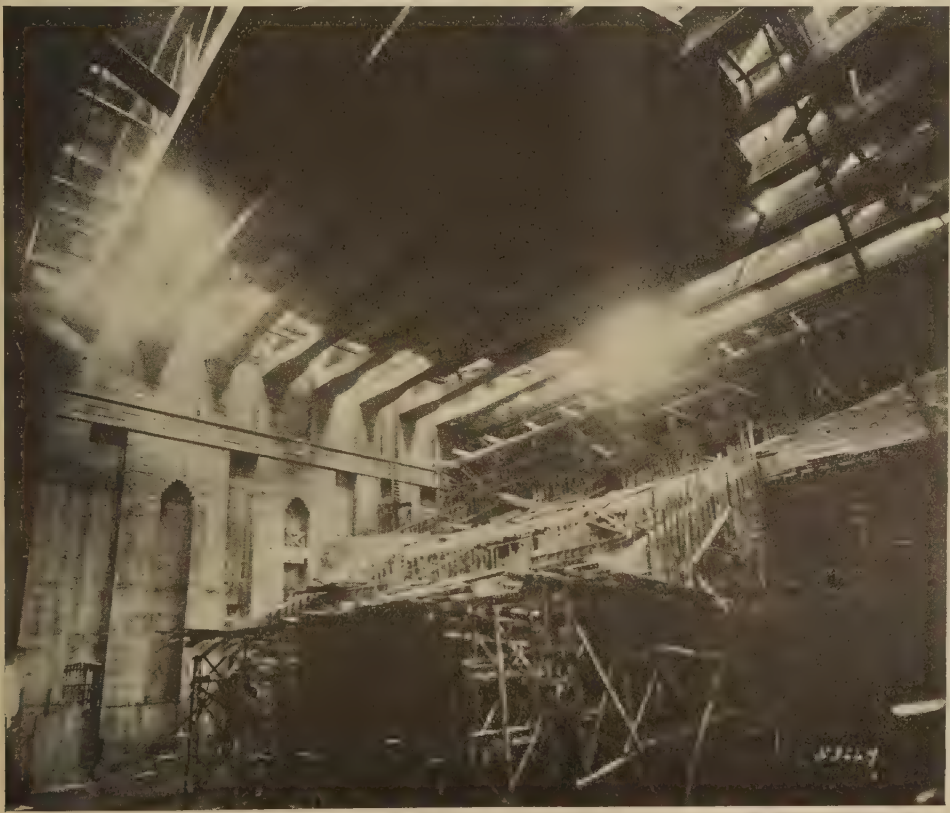
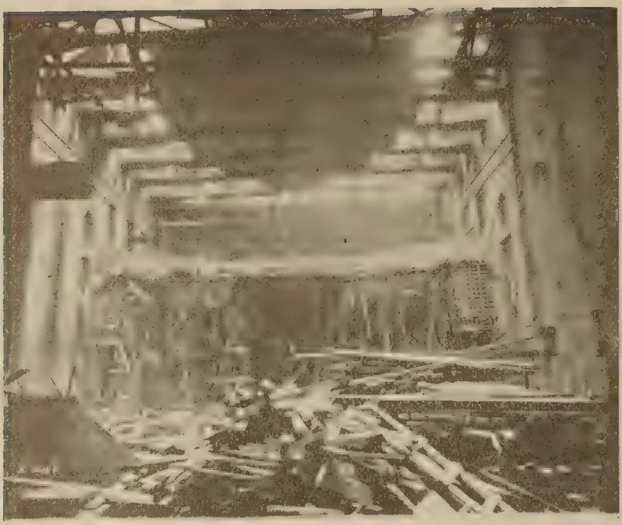
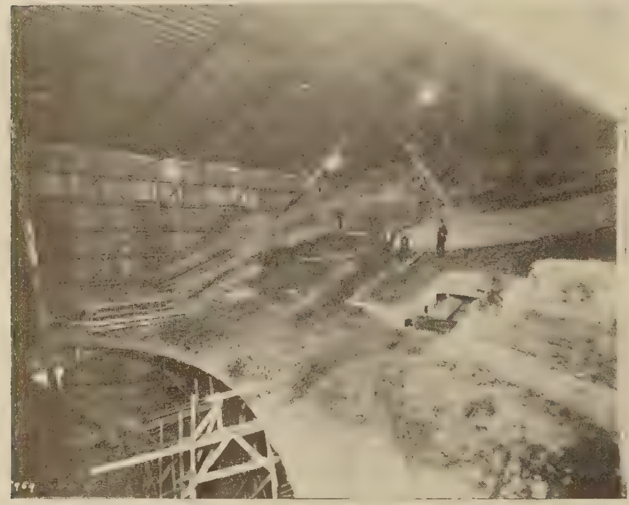


FIG. 1—INTERIOR VIEW OF THEATRE AUDITORIUM BEFORE THE BALCONY SLAB WAS PLACED. NOTE THE REINFORCED CONCRETE ROOF TRUSSES, THE 43-FT. CANTILEVER BALCONY TRUSS, ALSO THE REVERSED FORM WORK ON THE SIDE WALL





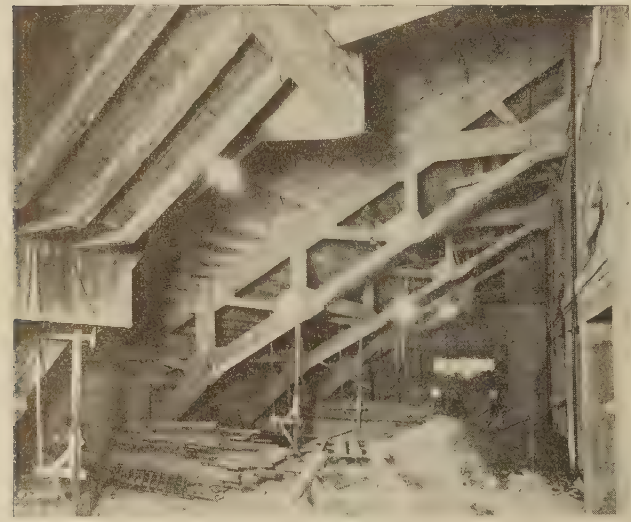
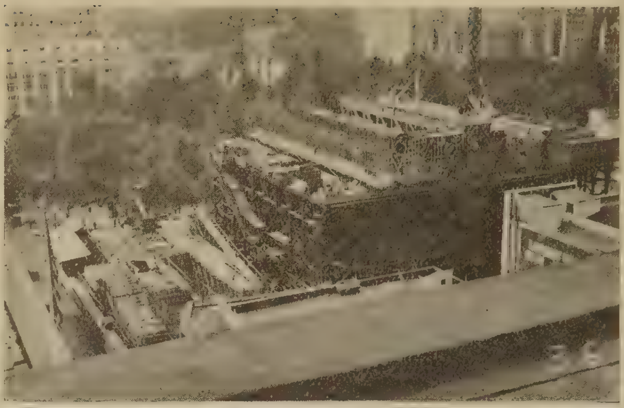


Fig. 2—Interior View of Auditorium Taken from Stage Showing the Roof Trusses, Also the Large Balcony Girder

Fig. 3—Interior View Showing Test Load Placed on Balcony. This Load Equalled 1,500,000 lbs. and is Equal in Weight to Approximately 7 Times the Weight of the People Who Can Be Seated in the Balcony. The Maximum Deflection in Balcony Girder is $\frac{7}{64}$ of an Inch

Fig. 4—View from Foyer Showing Underside of Balcony. Note the Reinforced Concrete Truss Anchor Arms, Also the Reversed Formwork Which Was Cast Directly in Place on the Bottom Chord of the Truss



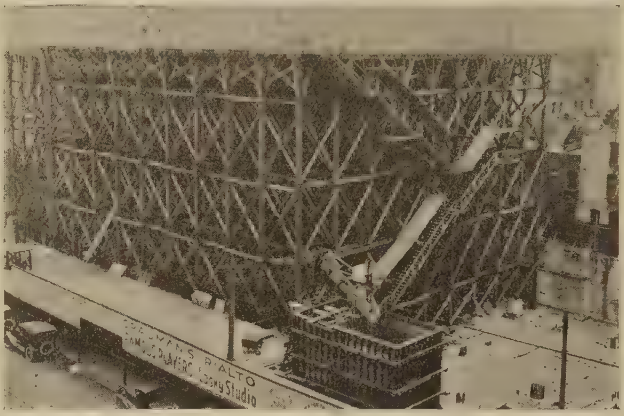


Fig. 5—General View of Building Showing the Placing of the Forms for the Roof Trusses, Also the Forms in Place for the Marquise Which Extends Out 12 Ft. Past the Building Line

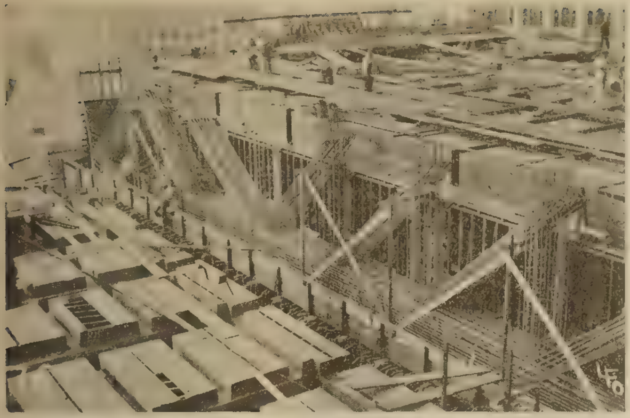
Fig. 6—General View of Falsework Used to Support the Forms for the Roof Trusses and Framing Over the Stage

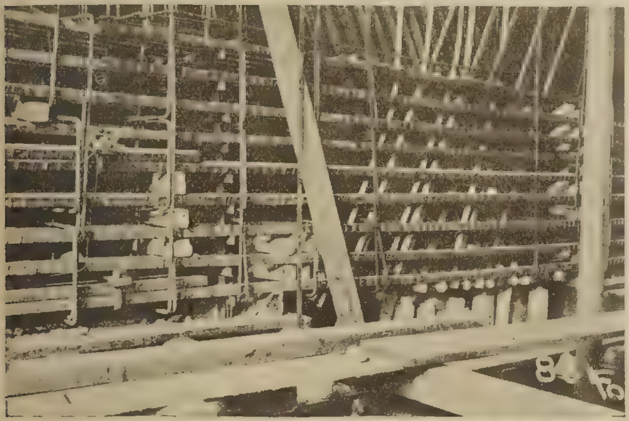
On the stage side of the building, the office section extends over the stage and is supported by the structural framing over the stage proscenium. The ends of the beams supporting the upper 5 stories of the building of the north wing are supported by the proscenium arch. On the alley side, the upper stories are supported by 10 roof trusses of 126-ft. span which also support the auditorium roof.

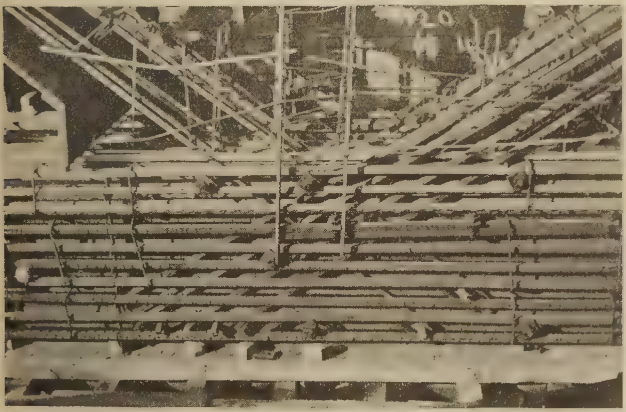
Original plans provided for a combination of reinforced concrete and structural steel. Structural steel was to have been used for columns, main girders, trusses and the framing over the stage. This plan involved the use of about 1,500 tons of steel and the exorbitant price asked for structural steel at the time made the cost of the building almost prohibitive; so investigation was made in an effort to devise some method of construction at a lower cost. As a result of the investigation, it was decided that considerable saving of time and money would result from constructing the entire building of reinforced concrete. Steel trusses, if used over the auditorium, would have had to be shipped knocked down and riveted as erected on the falsework. The necessary fireproofing would have made the steel members practically the same size as the reinforced concrete members used.

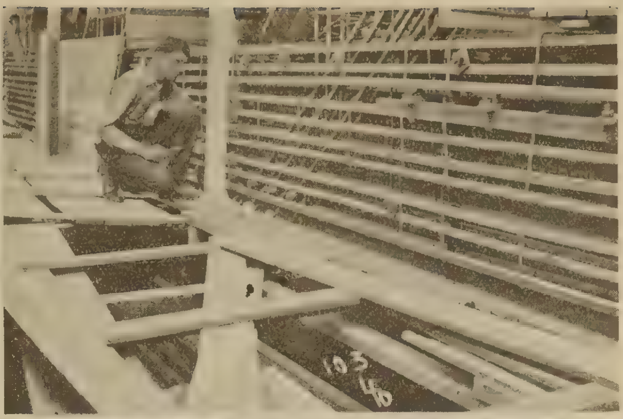
Unusual Structural Members

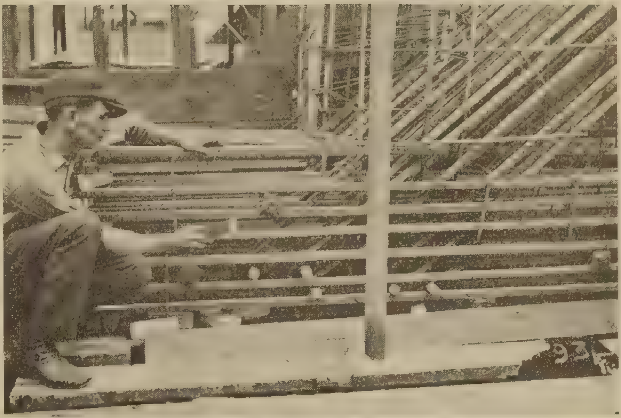
The balcony girder, the position of which is shown in Fig. 18 and the details in Fig. 19, is one of the most interesting and unusual features of the structure. It spans the entire width of the theatre, a distance of 126 ft., and supports the four cantilever balcony trusses. As shown in the illustration, two openings were provided for passageways through the girder to the balcony. The ends of the girder are supported by double core columns set in between the columns that carry the roof loads. The load carried by the girder is 2,000 tons.











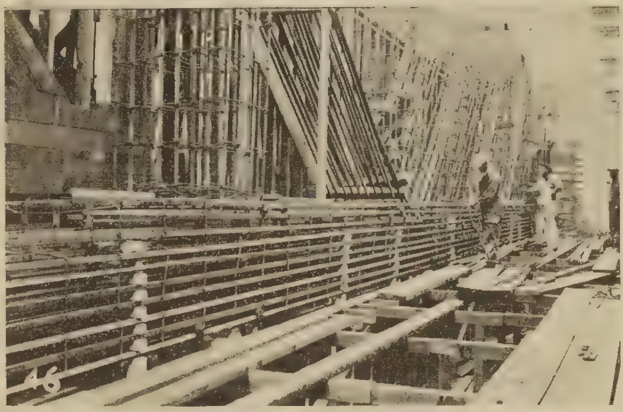


Fig. 7—General View of Steel Before Forms Were Placed of one of 10 Reinforced Concrete Roof Trusses

Fig. 8—Close-up View of Steel in Bottom Chord of Roof Truss. Note Cement Blocks Used to Carry the Weight of the Bars, the 1¼-in. x ¼-in. Bar Spacers Which Were Used to Hold the Reinforcing Bars in Place. Note the Splice of the Bottom Chord Bars with the ¾-in. "U" Clamps

Fig. 9—General View of Joint at Bottom Chord of Roof Truss

Fig. 13—Typical View of Panel Point in Bottom Chord of Roof Truss

Fig. 14—View of the Steel Reinforcing in Place for One of the Roof Trusses. Bottom Chord Has 100, 1¼-in. Bars.

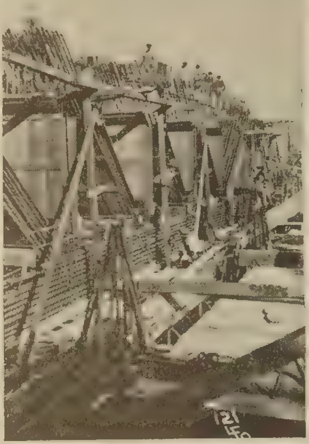
Fil. 15—General View of Bottom Chord of Roof Truss

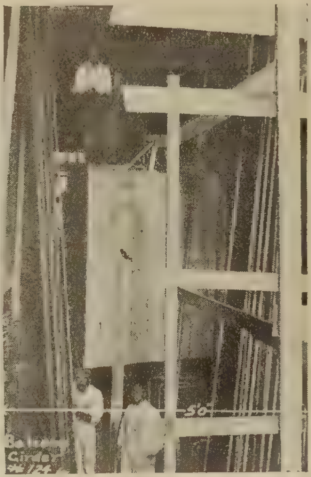
The reinforcing steel in the bottom of the girder at the center section consists of 204 1¼-in. square bars. In all, 110 tons of steel and 570 cu. yds. of concrete were used and the girder poured in one continuous operation lasting 47 hours. At the ends the girder is 26 ft. high and 6 ft. thick and the center section is 18 ft. 11 in. high and 5 ft. thick.

The four cantilever trusses which carry the balcony were cast with the girder and have a maximum overhang of 43 ft. They extend back 55 ft., being anchored to the columns in the south wall of the auditorium. Details of a typical cantilever truss are shown in Fig. 20.

The truss over the proscenium of the stage has a span of 87 ft. 6 in. and is 29 ft. 6 in. deep. It is a Howe type truss supported by two 60-in. columns. The supporting columns have 54-in. cores. Each core contains 52, 1¼-in. vertical bars and in addition there are 28, 1¼-in. bars outside the core to withstand stresses due to excessive loading. This proscenium girder carries the ends of the beams supporting the five floors of offices on the north side of the building, a load of about 1700 tons. Another girder 64 ft. long spans the proscenium opening and carries the west wall of the tier of offices above. This girder is 40 ft. deep, 3 ft. 10 in. thick and is supported by three 40-in. core columns.

In order to provide an exit 15 ft. wide on each side at the rear of the orchestra floor, the spacing between the main supporting columns which was normally 12 ft. 6 in. had to be spread and carried up about halfway and again drawn together to the regular spacing. The arrangement of the grouped columns at the rear of the stage necessitated two large combined cantilever footings as supports. A load of 5,200 tons is carried by each of the two footings on either side of the pros-





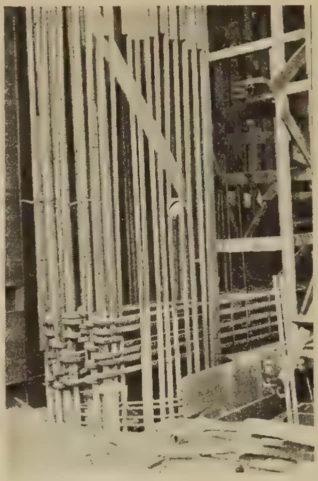
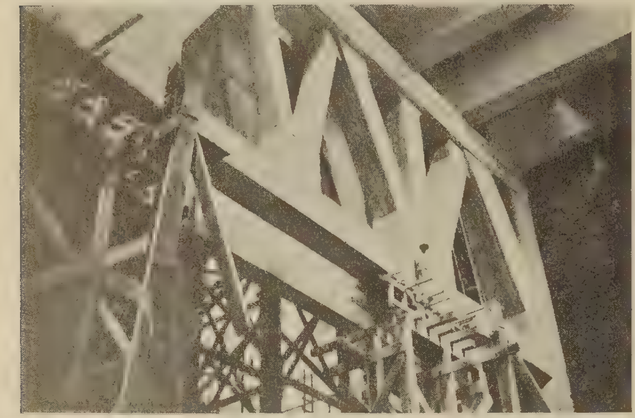


Fig. 10—General View of Roof Truss After Steel Has Been Placed, with Forms Being Placed Between Diagonal Members

Fig. 11—View Taken Inside of Balcony Girder. Box in Center of Picture is Passageway Through Girder to Balcony. The Vertical Steel Rods Shown are the Stirrups

Fig. 12—A View of the 56-in. Core Column Under Each End of Proscenium Arch Truss. This Shows General Method of Anchoring All Bottom Core Bars at End



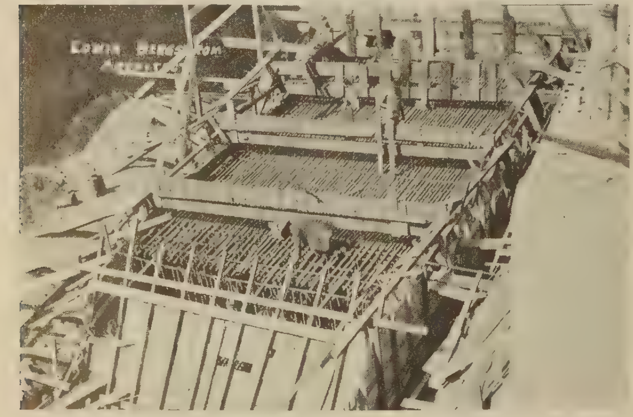


Fig. 16—This is ½ Elevation of Proscenium Arch Truss, a Span of 93 Ft. 6 in., 29 ft. 6 in. High, Total Load on Truss, 3,360,000 lbs. Supported at Each End by a Reinforced Concrete Column of the 56-in. Core, with 52, 1¼-in. Bars Inside of the Core, and 28, 1¼-in. Bars Outside of the Core to Take Bending

Fig. 17—Top View of One of the Large Combined Footings Which Support the Column at Each Side of the Stage and at the Rear of the Stage. This Footing is Approximately 56 ft. Long, 25 ft. 9 in. Wide, Contains 450 cu. yds. of Concrete, 28 Tons of Reinforcing Steel, and Carries a Load of 5,200 Tons; the Main Reinforcing Being 156, 1¼-in. Square Bars, and 460, ¾-in. Stirrups

cenium opening. Each footing, details of which are shown in Fig. 22, is 56 ft. long and 9 ft. 6 in. deep. The footings each contain about 450 cu. yds. of concrete and each has 156, 1¼-in. bars at the top and 460, ¾-in. stirrups.

A continuous footing 5 ft. 6 in. thick in the form of an inverted T extends along the alley for a distance of 164 ft. The maximum width is 19 ft. A 4-ft. distributing wall furnishes direct support for the double core columns which carry the roof trusses and the balcony girder.

Ten Howe trusses with a span of 126 ft. carry the auditorium roof and the five floors of offices above, on the alley side of the building. These trusses are each 15 ft. 8 in. deep and contain 231 cu. yds. of concrete and 61 tons of steel. The top chord is 4 ft. x 6 ft. and the bottom chord is 3 ft. 2 in. x 3 ft. 6 in., the latter being reinforced with 100, 1¼-in. bars. The trusses each weigh about 5 tons per lineal foot and carry loads of 750 tons. The ends of the trusses are directly supported by two double core columns, each core being 36 in. in diameter reinforced with 30, 1⅛-in. bars. Steel bars inside the cores are designed to carry the direct load and additional bars outside the hooping extend from the foundation to the top of the roof truss to take the bending.

The reinforced concrete marquise is 89 ft. long and extends 12 ft. beyond the building line. The girders by which the marquise is supported extend back into the building and are connected to the girder spanning the lobby.

Construction Methods

Falsework for the auditorium and stage trusses was erected to a height of 90 ft. upon the footings for the columns that support the theatre floor. One hundred posts for the auditorium and 67 for the stage were carried up of 12-in. x 12-in. timbers. The work was carried up in 5 bents and the entire framework bolted together. Sleepers 8 in. x 8 in. were placed on top of the falsework to carry the 2-in. plant working floor. The forms for the trusses and roof were constructed above this floor. About 400,000 ft. B. M. of lumber was required for the falsework. The way in which the falsework was built up is shown in Figs. 5 and 6.

The walls were erected around the falsework up to the bottom of the roof trusses. At the same time, forms were erected and reinforcing placed for the roof trusses so that concrete for the roof framing could be poured by the time the walls were built up to this point. After the roof trusses were poured, the balcony cantilevers and their supporting girder were constructed without removing any of the falsework.

The next step was the pouring of the floor section on the balcony followed by the building of the stage and the first floor of the auditorium. The balcony floor was built after the forms for girders and trusses were removed.

Ordinary construction methods were followed out in building the forms, using 2-in. x 4-in. pieces and ⅞-in.

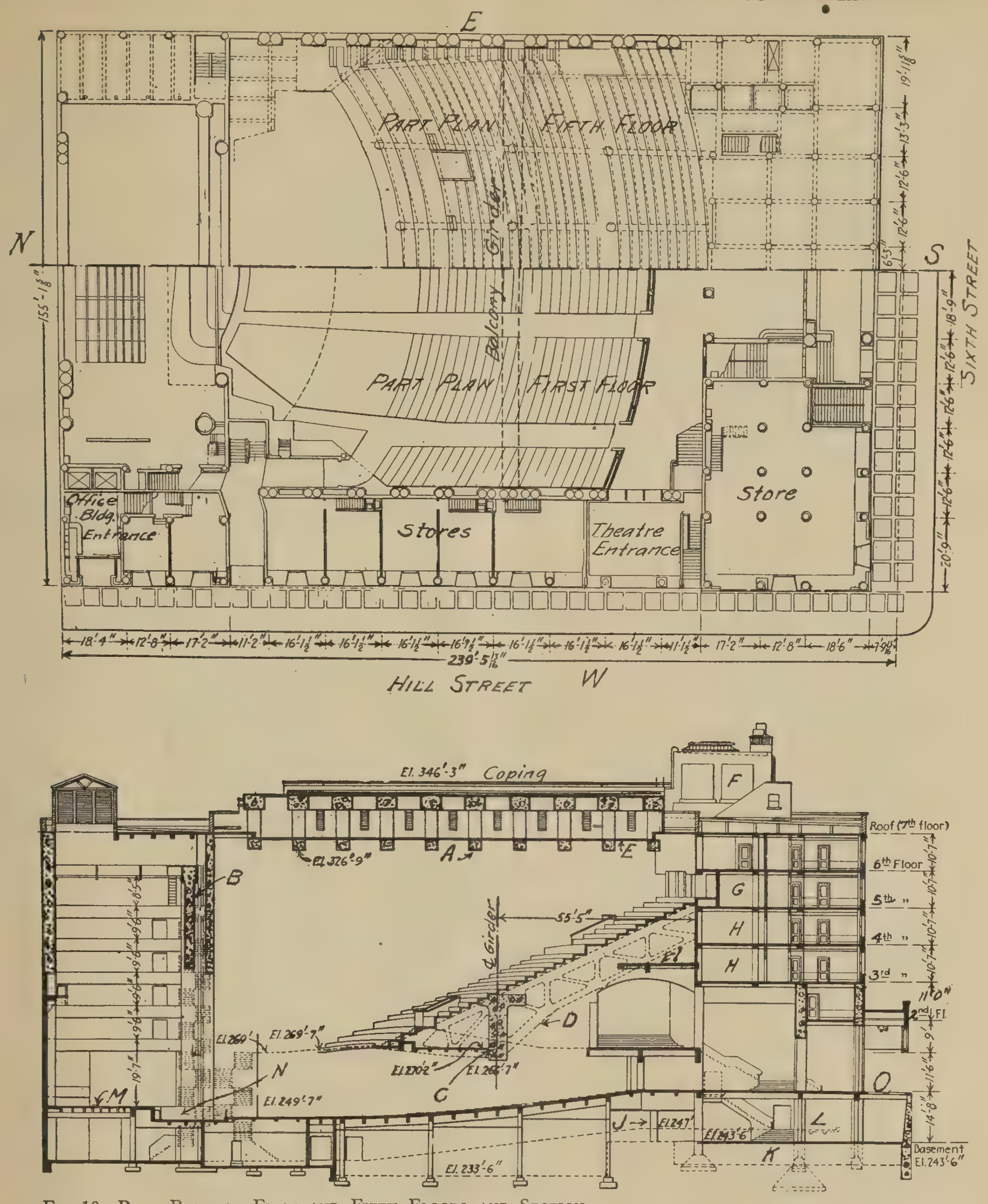


Fig 18—Part Plan of First and Fifth Floors and Section Through Theatre Showing Location of Unusually Heavy Structural Members

(A) Roof trusses
(B) Proscenium truss
(C) Balcony Girders
(D) Balcony Cantilever Trusses
(E) Concrete Slab
(F) Tanks
(G) Janitor Storage
(H) Storage
(I) Fan
(J) Elevator Lobby
(K) Boiler and Switch Board Room
(L) Pump Balcony
(M) Storage Floor
(N) Orchestra Pit
(O) Lobby Floor

form lumber. On the top floor covering the falsework, 4-in. x 4-in. pieces set on wedges were used as immediate supports for the truss and girder forms.

In constructing forms for the trusses, a full-sized template of the trusses was laid out on the falsework floor and box-like sections of forms were made and put in place following the erection of the steel. The concrete was allowed to harden for 60 days after pouring before the forms were removed.

The soffits of the roof trusses were put in place first with their reversed decorative forms. The next step was to lay out and fasten in place the steel in the bottom chord. Details of the spacing are shown in Fig. 23. Spacers were made of 1¼-in. square bars bolted together and cement blocks used to carry the load as shown in Fig. 8. These blocks were carefully staggered to allow for the placing of the concrete.

One and one-quarter inch square bars 65 ft. long were used in the bottom chord, the bars being lapped 6 ft. at splices and held together by ¾-in. U clamps. Splices

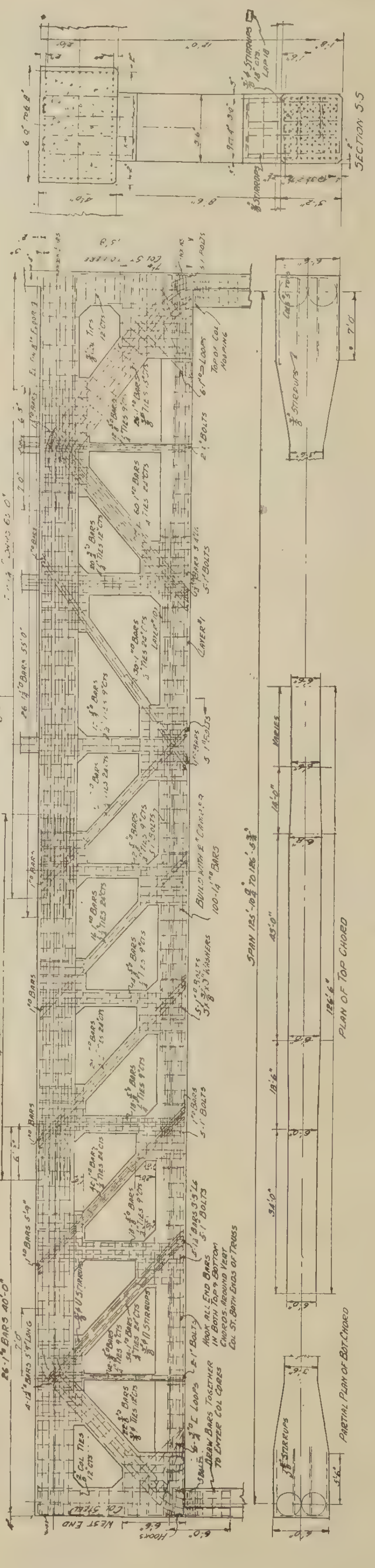


FIG. 19—DETAILS OF TYPICAL ROOF TRUSS

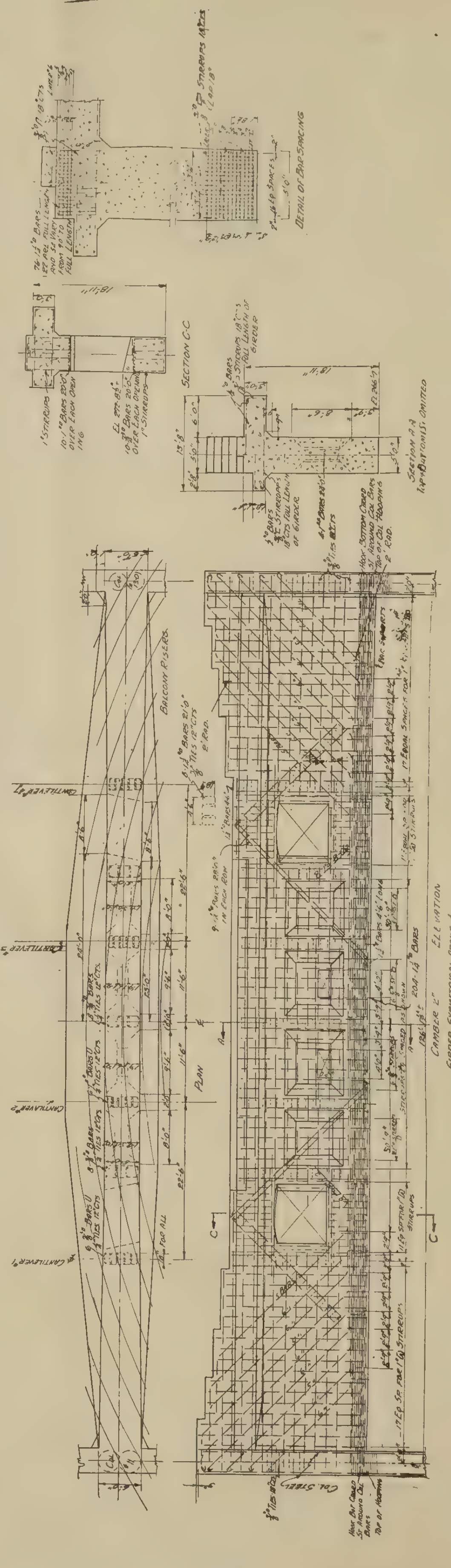


FIG 20—DETAILS OF BALCONY GIRDER SHOWING OPENINGS FOR PASSAGE WAYS FROM FOYER TO THE FRONT OF BALCONY

FIG. 21 — DETAILS OF TYPICAL CANTILEVER TRUSS SHOWING FRAMING WITH BALCONY GIRDER

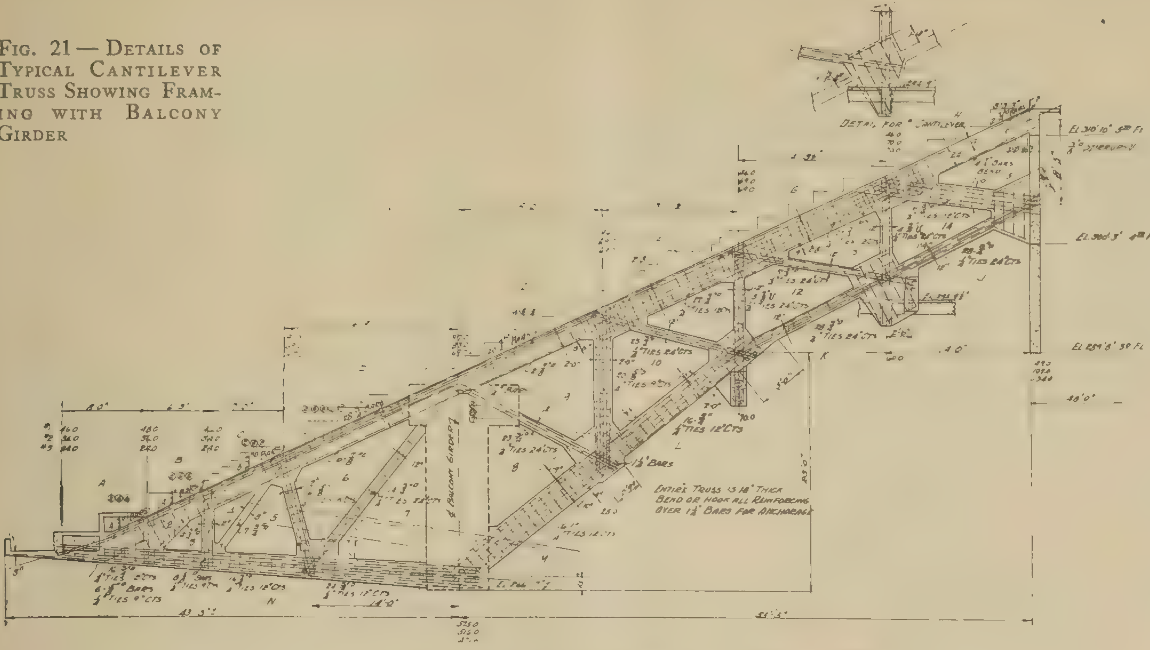
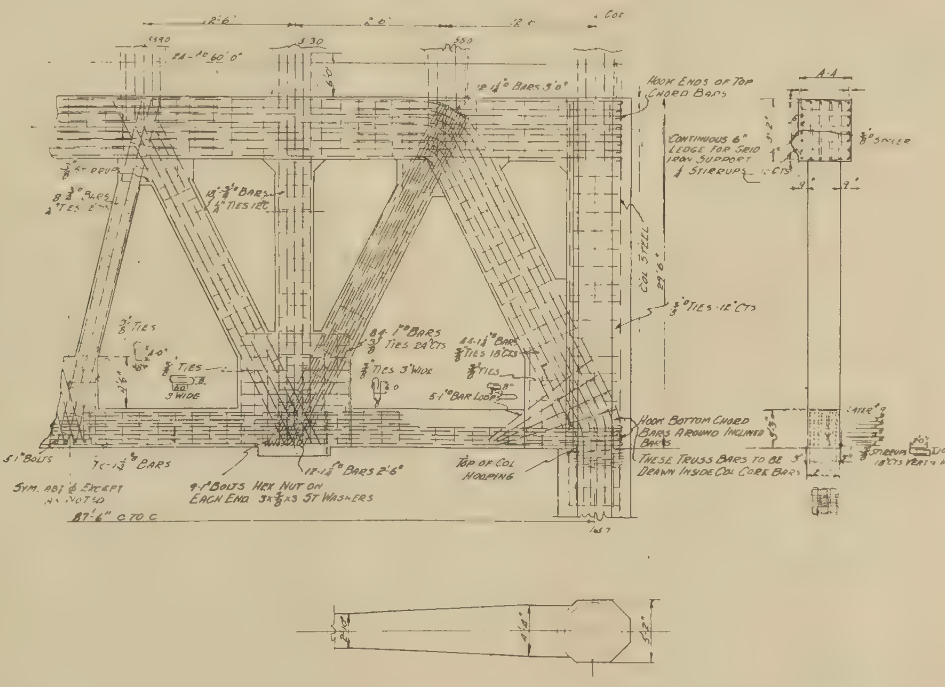

DETAIL FOR CANTILEVER
BALCONY GIRDER
ENTIRE TRUSS IS 18" THICK BEND OR HOOK ALL REINFORCING OVER 1½" BARS FOR ANCHORAGE

FIG. 22—DETAIL OF HALF OF REINFORCED CONCRETE TRUSS OVER PROSCENIUM


HOOK ENDS OF TOP CHORD BARS
CONTINUOUS 6" LEDGE FOR GRID IRON SUPPORT
COL STEEL
HOOK BOTTOM CHORD BARS AROUND INCLINED BARS
THESE TRUSS BARS TO BE DRAWN INSIDE COL CORE BARS
TOP OF COL HOOPING
9-1" BOLTS HEX NUT ON EACH END 3x⅝x3 ST WASHERS
SYM. ABT ℄ EXCEPT AS NOTED
87'-6" C TO C

in adjacent bars were located so as to stagger the lapped sections. At the ends of the bottom chord reinforcing in the trusses, the bars were hooked around the vertical bars in the columns. Reinforcing bars in the diagonal tension members of the trusses were hooked around a cross bar at each end, the diagonal bars being worked in between the steel in the bottom chord. The arrangement of the bottom chord steel and the hooked diagonal steel bars as well as the box-like section of forms is shown in Fig. 10. The building of the trusses in pairs allowed building up the sides of two adjacent trusses and the form work for them before the steel was placed.

CONCRETING PLANT

Fig. 24 shows the layout of the plant in the basement of the building. Two concrete mixers, together with their conveyors, elevators and bins were provided, one mixer at either end of a row of bins. Material was stored under the shop section on the Hill street side. Trucks were driven directly off the street onto a platform and their loads discharged into the bins below. One bin had a capacity of 2,000 bbls. of cement, another, 950 cu. yds. of sand and the third, 1,200 cu. yds. of crushed stone. These bins stored sufficient material to pour two of the auditorium trusses. Electrically operated mechanical conveyors carried the material from the bins to the mixers. Duplicate parts for both mixers were kept on hand as a further precaution against delays due to breakdowns and two separate sources of electrical power were available.

Each of the large trusses or girders was poured in one continuous operation. The roof trusses were poured in a continuous run of 7 hours on 10 consecutive days. The bottom chord was poured full at one end and the concrete gradually worked for the full length. Next the diagonal members were poured and finally the top chord and roof. In pouring the stage framing, balcony girder and cantilever trusses, practically the same scheme was carried out.

The concrete mixers were of the 1-yd. batch type and

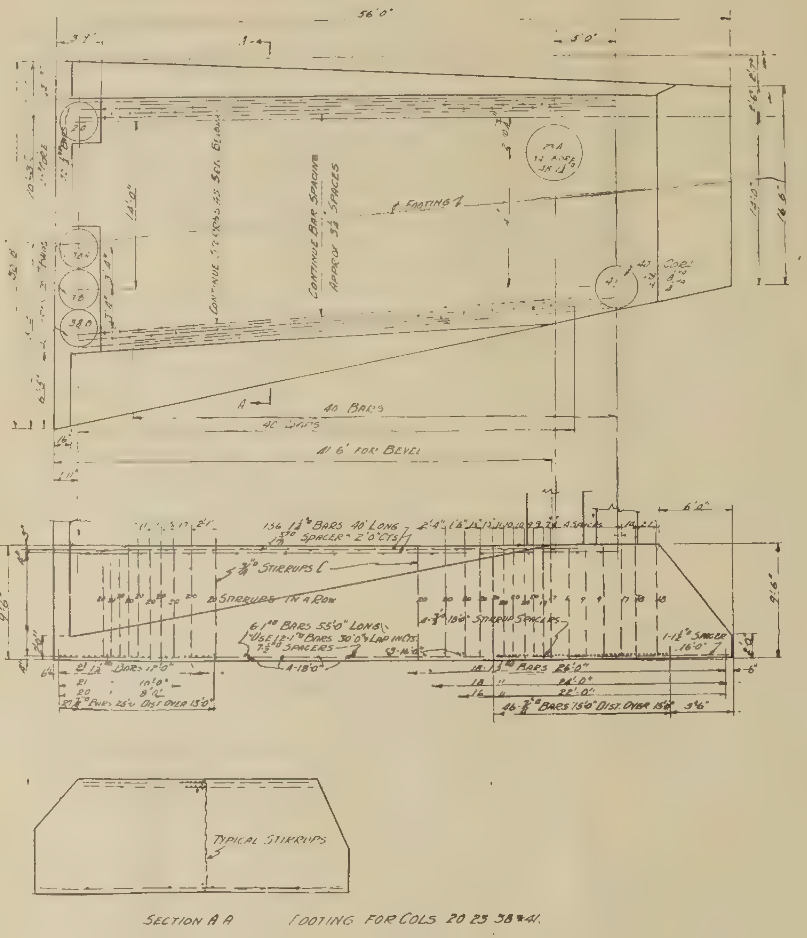


Fig. 23—Footing Details for Grouped Columns

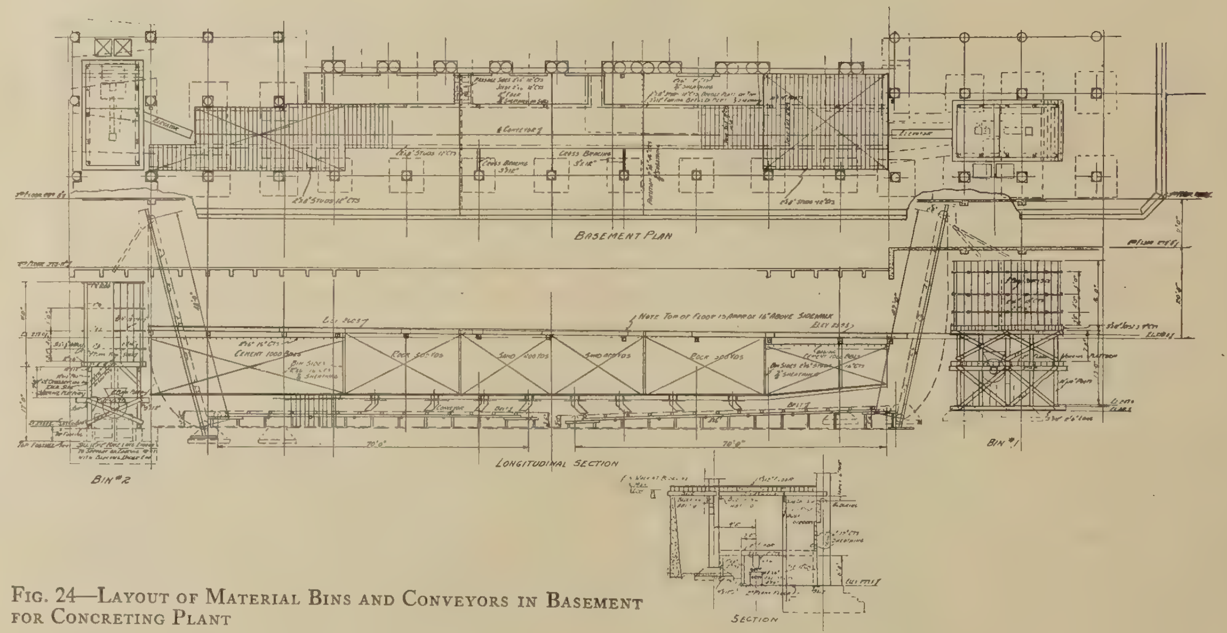


Fig. 24—Layout of Material Bins and Conveyors in Basement for Concreting Plant

the concrete was hoisted and placed in the forms from wheelbarrows and buggies without any chuting.

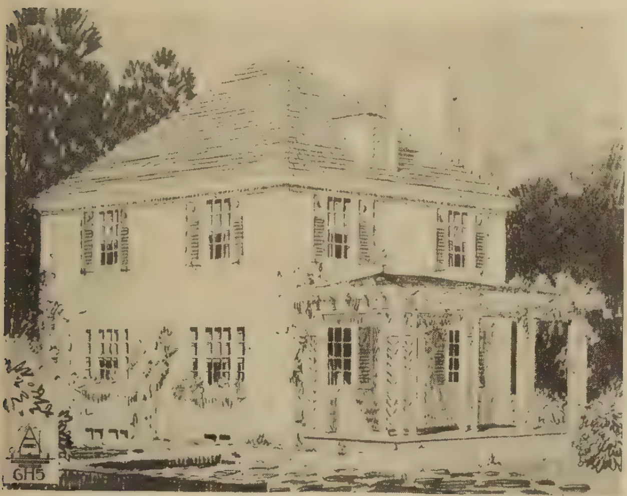
Concrete used was of a 1:2½:3½ mix, washed sand and ¾-in. rock being used as aggregates. All steel and cement were tested and particular care was taken to maintain the concrete at the proper consistency so that it could be placed around the reinforcing. The requirements of the Joint Committee on Concrete and Reinforced Concrete, 1921, as to unit stresses, were followed in the design.

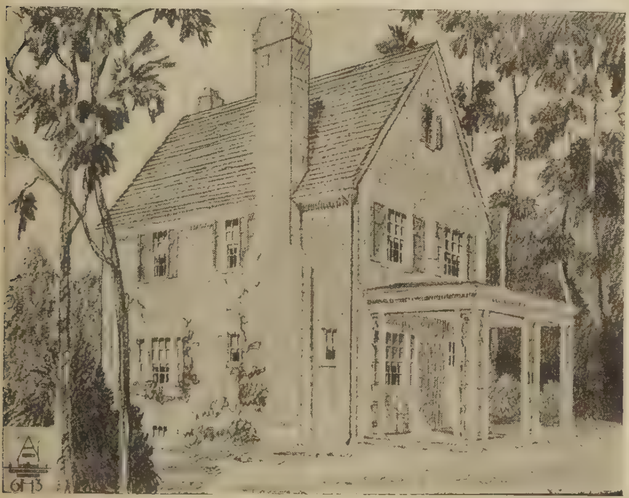
Three Plans for Concrete Block Houses

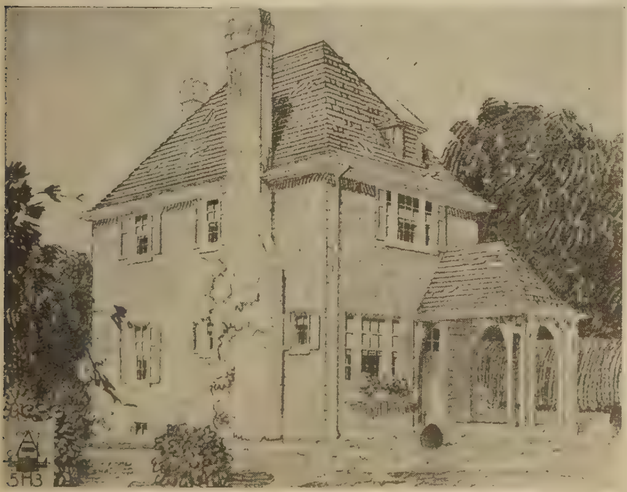
A demand for house plans drawn with concrete block construction especially in view has caused the Potomac Division, Inc., of the Architects Small House Service Bureau, 302 Ferguson Bldg., Pittsburgh, to prepare complete drawings for three small concrete block houses, sketch plans, detail sections and perspectives of which are reproduced herewith.

William H. King, Jr., of the Potomac Division, says:

> The working drawings call for walls of concrete block 8 in. thick. The windows are worked out so as to work with the block courses. Stock frames are used and the difference in size is taken up in special cast concrete window sills. If the concrete block manufacturers are going in for furnishing material for houses of this kind, they must be prepared to make some few special blocks. We understand that ¼ and ½ blocks are now made but it will be necessary in some instances to make special size blocks or to cut them at the building. Of course, this procedure is practical.
>
> It will be noticed that in two of the three houses, we have used hipped roofs. The idea is to avoid having to make a block with a rake as shown for the gable on House No. 6H3.







Figs. 1 and 2—Architect's Perspective of Houses (Top to Bottom) 6H5 and 6H3

Fig. 3—Concrete Block House 5H3

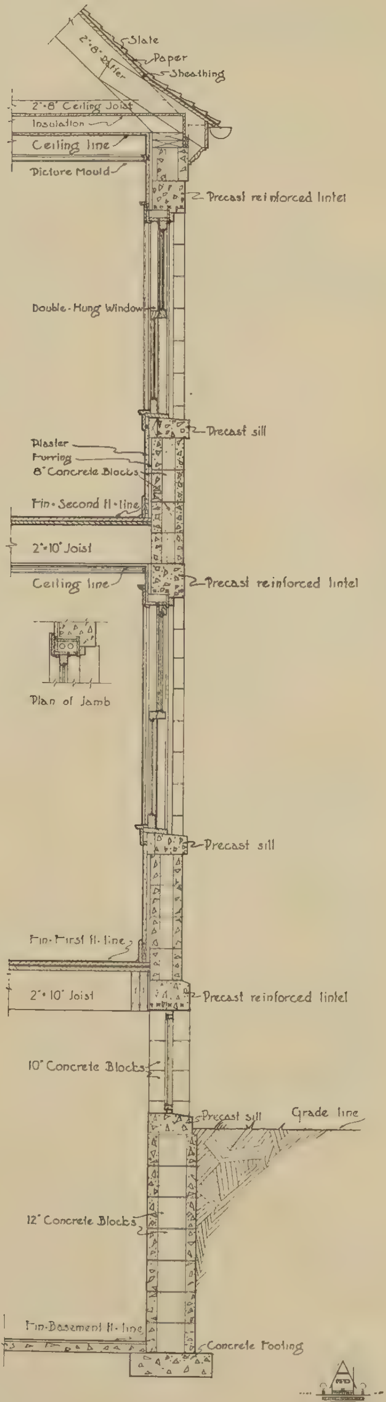
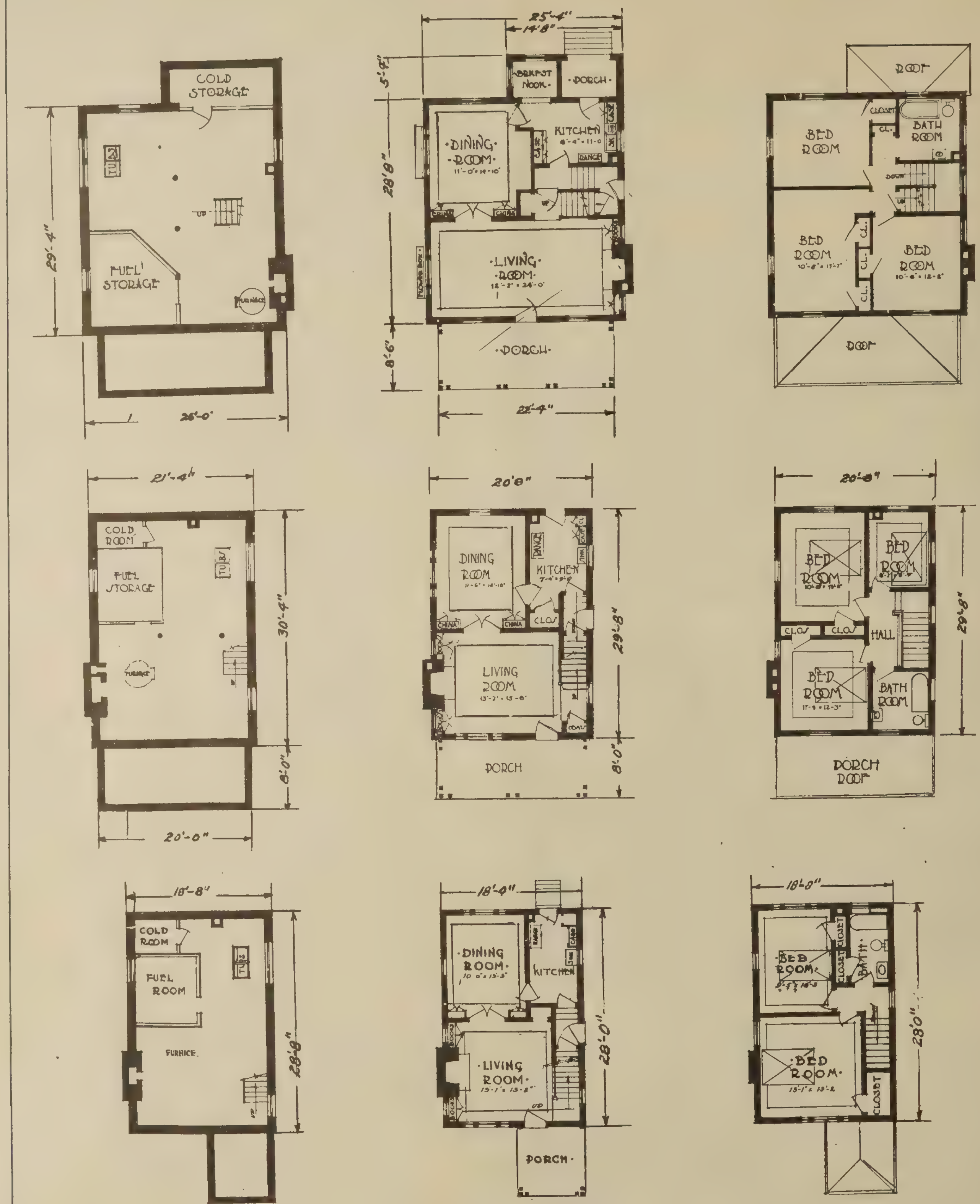


Fig. 7—Section Through Walls of Houses 5H3, 6H3 and 6H5



Figs. 4, 5 and 6—(Top to Bottom) Floor Plans of Houses 6H5, 6H3 and 5H3

6H5 Story Heights are: Basement 7 ft., 1st floor, 8 ft. 4 in., 2nd floor 8 ft.
6H3, Basement 7 ft., 1st story, 8 ft. 9 in., 2nd story, 8 ft.
5H3, Basement 7 ft., 1st story, 8 ft. 4 in., 2nd floor, 8 ft.

I believe that a great majority of architects will agree with me in the statement that concrete block of imitation rock face has absolutely no artistic quality and is very, very ugly. This organization, therefore, wishes to discourage the use of concrete block of that kind. We see quite a use for concrete block—the surface of which has been made with certain chips of granite-like appearance or other aggregates of character. We considered, in making plans for these houses, the possibilities of using the panelled blocks. We decided that this procedure would need special blocks for particular places and such arrangement would not allow for flexibility.

House Insulation and Fuel Consumption

By H. J. Burt
Structural Engineer, Holbird and Roche, Architects, Chicago

The most direct way for a householder to cut down the cost of his winter's coal supply is to buy and to burn a smaller quantity of it. Can he do this without sustaining inconvenience, discomfort or ill health? In case he is building a new house the answer is affirmative with emphasis. If he has an old house the answer is still affirmative.

The means of accomplishing this result is by the use of insulation.

Every building material offers some resistance to the passage of heat. Even a thin sheet metal enclosure is somewhat better than nothing. Wood, brick and plaster have considerable value, if of sufficient thickness. The construction commonly used in houses is accepted as good only because the householder does not realize that it could be made very much better.

The first step toward a warmer house is to make the householder realize that houses can be insulated easily, with materials manufactured expressly for that purpose. The next step is to show him that partial insulation can be had with no increase in the cost of the building, and that thorough insulation can be had for such a small amount that it will be repaid in a very few years by the saving in coal. And the last step is for Mr. Householder to insulate his home, save money from his fuel bill, and live in much greater comfort than before.

Insulating materials suitable for house building and made expressly for that purpose have been on the market for a comparatively short time and are not as well known as brick and lumber and plaster which are familiar to everyone. Insulating lumber is now a commercial article, available on the market at a reasonable cost. Its use is spreading rapidly, so it will not be long until it will be one of the essential materials in building a house.

The purpose of insulation is to prevent the passage of heat from the inside of the house to the outside air. A familiar illustration of this loss of heat is the rapid melting of snow on the roofs of houses. A large amount of heat is wasted through roofs and also through walls.

All materials permit the passage of heat, some a great amount and others very little. The poorest conductor of heat is the best insulator. Careful tests have been made of the passage of heat through the materials commonly used, so that their values are known. These values are expressed technically in terms of British thermal units, per square foot of surface, through one inch thickness of material, in one hour, for each degree difference in temperature. Thus a piece of insulating lumber one foot square and one inch thick will permit the passage of 0.33 B.t.u. in one hour if the temperature on one side is one degree greater than on the other side. For 10° difference the heat lost will be 10 times as great, or 3.3 B.t.u. If the insulation is only one half as thick the conductance will be twice as great.

The merit of insulating lumber is shown by the following comparisons:

Insulating lumber	0.33
Wood sheathing	1.25
Plaster	1.50
Brickwork	4.00
Concrete	6.00

All of the above values are for one inch thickness.

Expressed in another way, one inch of insulating lumber is equal to 3¾ inches of wood, 4½ inches of plaster, 12 inches of brick or 18 inches of concrete.

Experiments and computations give the heat loss through walls and roofs of various types with and without insulation. The following table gives some typical values arranged to show the percentage of saving resulting from the use of insulation:

WALL SECTIONS

Construction	Non-Insulated Conductance	Insulated Conductance	Percent Saving
Wood siding, building paper, wood sheathing ⅞-in., lath and plaster	0.265		
Wood siding, insulating board as sheathing, insulating board as plaster base, plaster		0.182	31%
Stucco, building paper, wood sheathing, lath and plaster	0.267		
Stucco, insulating board as sheathing, insulating board as plaster base, plaster		0.183	31%
Brick veneer 4-in., building paper, wood sheathing, lath and plaster	0.24		
Brick veneer 4-in., insulating board as sheathing, insulating board as plaster base, plaster		0.17	29%
Brick wall 8-in., furring, lath and plaster	0.24		
Brick wall 8-in., furring, 2 layers of insulating board serving as plaster base, plaster		0.143	40%
ROOF SECTIONS			
Wood shingles on wood strips spaced 2 in. apart	0.667		
Wood shingles on wood strips, insulating board sheathing		0.35	47%
Wood shingles, wood sheathing ⅞-in.	0.455		
Wood shingles on wood strips, insulating board sheathing, insulating board lining under rafters		0.191	58%
Clay tile ½-in., Roofing felt, wood sheathing.	0.496		
Clay tile ½-in., wood strips, insulating board sheathing, insulating board lining under rafters		0.208	58%
Asphalt shingles, wood sheathing ⅞-in.	0.553		
Asphalt shingles, 2 layers insulating board as sheathing		0.25	55%
Composition roof, wood deck 2-in.	0.322		
Composition roof, 2 layers insulating board, wood deck 2-in.		0.17	47%
Composition roof, concrete deck 3-in.	0.65		
Composition roof, 2 layers insulating board, concrete deck 3-in.		0.24	63%

(In all of the above items the insulation used is ½-in. thick.)

The amount of insulation desirable for a house depends on climatic conditions. For average conditions two layers of one-half inch insulating lumber are sufficient.

For the outside walls of a frame house one layer of insulating lumber is used on the outside of the studs, taking the place of the wood sheathing and the building paper. The other layer is placed on the inside of the studs and serves instead of lath as a base for plaster. In a locality where average prices prevail the outside layer in place will cost less than the wood sheathing and paper in place; the inside layer will cost somewhat more than the lath but will save some labor and material on the plastering. The two layers combined will practically balance the cost of the items they replace. Thus the owner gets his walls well insulated at no additional cost above that of uninsulated construction.

The most effective place for insulating the top of a house is at the ceiling or attic floor. One layer of the insulating lumber should be put on the under side of the joists serving instead of lath as the base for plaster, the other should be placed on top of the attic joists. The saving of the lath will largely offset the cost of one layer. The other layer does not replace any material that would otherwise be used. For a house 30 ft. x 40 ft. this will amount to about $100.00.

The foregoing statements show that the insulation of the walls can be had with no added cost and the insulation of the top of the house for a little more than the cost of one layer of insulating lumber. In two typical cases this extra cost amounted to less than 2% of the cost of the house.

The actual saving in a given case must be computed for the conditions of that case. The variable elements are so many that a general solution will not apply. A number of cases have been computed showing savings in fuel varying from 20 to 40%. It is reasonable to say that careful insulation of an ordinary residence will effect a saving of at least 25% of the fuel cost.

Existing houses also may be insulated, though not so readily as new ones. It is not practicable to insulate the walls of an old house unless other changes are being made. A great many old houses are being altered by changing the outside covering from wood to stucco or brick veneer. While this is being done the insulation can be installed as readily as in a new house. In some houses the plaster is renewed. This also gives opportunity to incorporate the insulating lumber. The top of the house is easy to protect, by placing the insulation over the ceiling joists. If the attic is large enough to be usable the insulation should be applied on the underside of the rafters, thus making the attic as comfortable for living purposes as the remainder of the house.

Insulation is a matter of comfort as well as economy. Now that materials for this purpose are available at a reasonable cost, it is certain to become a standard practice in home building.

The following data are from a report by G. F. Gebhardt, mechanical engineer, Chicago, to H. J. Burt.

We submit herewith results of our estimate on the coefficients of heat transmission for walls and ceilings, details of which were submitted by you recently. We also submit tables of heat conductivity coefficients and surface factors for the various materials entering into the proposed construction. The coefficients of heat transmission are expressed in B.t.u. transmitted per square foot of surface per hour per degree Fahrenheit difference in temperature between the inside and outside air.

WALL SECTIONS

Number	Construction	Coeff. of Heat Transmission B.t.u. per sq. ft. per hour
1	Wood siding (clapboard or shiplap) on studs. No inside lining	0.57
1a	Celotex $\frac{7}{16}$-in. thick on siding. No inside lining	0.42
2	Wood siding. Building paper, wood sheathing ⅞-in. No inside lining	0.41
2a	Wood siding. Celotex sheathing. No inside lining	0.35
3	Wood siding. Building paper. Wood sheathing ⅞-in., lath and plaster	0.265
3a	Wood siding. Celotex sheathing. Lath and plaster	0.24
3b	Wood siding. Celotex sheathing. Celotex plaster on Celotex	0.182
4	Stucco, building paper, wood sheathing, lath and plaster	0.267
4a	Stucco, Celotex sheathing, lath and plaster	0.24
4b	Stucco, Celotex sheathing, Celotex as plaster base, plaster	0.183
5	Brick veneer 4-in., building paper, wood sheathing, lath and plaster	0.24
5a	Brick veneer 4-in., Celotex sheathing, lath and plaster	0.217
5b	Brick veneer 4 in., Celotex sheathing, Celotex as plaster base, plaster	0.17
6	Brick wall 8-in., furring, lath and plaster	0.24
6a	Brick wall 8-in., furring, Celotex, plaster on Celotex base	0.182
7	Brick wall 12-in., furring, lath and plaster	0.193
7a	Brick wall 12-in., furring, Celotex, plaster on Celotex base	0.154
8	Stucco, tile wall 8-in., furring, lath and plaster	0.19
8a	Stucco, tile wall 8-in., furring, Celotex, plaster on Celotex base	0.153
9	Stucco, concrete wall 6-in., furring, lath and plaster	0.267
9a	Stucco, concrete wall 6-in., furring, Celotex, plaster on Celotex base	0.198
10	Stucco, concrete wall 12-in., furring, lath and plaster	0.21
10a	Stucco, concrete wall 12-in., furring, Celotex, plaster on Celotex base	0.165

ROOF SECTIONS

1	Wood shingles on wood strips spaced 2-in. apart	0.667
1a	Wood shingles on wood strips. Celotex sheathing	0.35
2	Wood shingles, wood sheathing ⅞-in.	0.455
2a	Same as No. 1a	0.35
2b	Wood shingles on wood strips, Celotex sheathing, Celotex lining under rafters	0.191
3	Metal shingles on wood strips spaced 2-in. apart	Practically no heat insulation
3a	Metal shingles on wood strips, Celotex sheathing	0.54
3b	Metal shingles on wood strips, Celotex sheathing, Celotex lining under rafters	0.236
4	Metal shingles, wood sheathing, ⅞-in.	0.833
4a	Metal shingles, on wood strips, Celotex sheathing	0.54
4b	Metal shingles on wood strips, Celotex sheathing, Celotex lining under rafters	0.236
5	Slate 1-in., roofing felt, wood sheathing, ⅞-in.	0.444
5a	Slate 1-in., wood strips, Celotex sheathing	0.372
5b	Slate 1-in., wood strips, Celotex sheathing, Celotex lining under rafters	0.197
6	Clay tile ½-in. Roofing felt, wood sheathing	0.496
6a	Clay tile ½-in., wood strips, Celotex sheathing	0.412
6b	Clay tile ½-in., wood strips, Celotex sheathing, Celotex lining under rafters	0.208
7	Asphalt shingles, wood sheathing ⅞-in.	0.553
7a	Asphalt shingles, Celotex sheathing	0.407
	Asphalt shingles, Celotex sheathing, 2 layers	0.25
8	Asbestos shingles, wood sheathing ⅞-in.	0.55
8a	Asbestos shingles, wood strips, Celotex sheathing	0.404
9	Composition roof, wood deck 2-in.	0.322
9a	Composition roof, Celotex, wood deck 2-in.	0.22
9b	Same as 9a, except two layers Celotex	0.17
9c	Same as 9a except three layers Celotex	0.14
10	Composition roof, concrete deck 3-in.	0.65
10a	Composition roof, Celotex, 1 layer, Concrete deck 3-in.	0.35
10b	Same as 10a, except two layers Celotex	0.24
10c	Same as 10a, except three layers Celotex	0.18

CONDUCTIVITY CONSTANTS

Wood siding	1.4
Celotex	0.33
Wood sheathing	1.25
Wood deck, soft pine	1.0
Building paper, one thickness	4.2
Wood lath and plaster	1.4
Plaster	1.5
Portland cement stucco	2.0
Common brick	4.0
Hollow clay tile	3.2
Concrete	6.0
Wood shingles	1.0
Slate	2.5
Tar and felt roofing, 5-ply (as laid, not per inch)	5.0
Clay tile	3.5
Asphalt shingles (as laid, not per inch	6.5
Asbestos shingles (as laid, not per inch)	6.0
Composition roof (as laid, not per inch)	6.5

The above table gives the coefficient of internal heat conductivity expressed in B.t.u. passing through one square foot of the material per hour per degree Fahrenheit difference in temperature between the inside and the outside surface for a 1-in. thickness unless otherwise stated.

SURFACE CONSTANTS

Wood Siding	2.1
Celotex	1.9
Wood sheathing	2.0
Lath and Plaster	2.3
Portland cement stucco	2.3
Common brick	2.3
Clay tile	2.3
Concrete	2.3
Wood shingles	2.0
Slate	2.3
Tar and felt roofing	2.1
Asphalt shingles	2.2
Asbestos shingles	2.2

The above table gives rates of heat absorption and emission expressed in B.t.u. per square foot of surface per hour per degree Fahrenheit difference in temperature between wall surface and surrounding air.

River Terminal Formed of War-Time Barges

WAR TIME BARGES MAKE RIVER TERMINAL

War-time barges of reinforced concrete built by the U. S. Government for service in New York harbor are now performing an entirely different service. They form a river terminal at Cairo, Ill., handling freight that travels along the Ohio and Mississippi. While the war was on, these barges were used for transferring cars at New York. Later, they were towed down from New York and around Key West to New Orleans by vessels of the U. S. Shipping Board. On reaching New Orleans they passed into the control of the Mississippi-Warrior Federal Barge Line. These barges are of substantial construction, and are 226 ft. long by 36 ft. wide. By placing them side by side it was possible to build warehouses on them 200 ft. long and 56 ft. wide. Car-float barges are also used that are connected by steel trusses. They are coupled to the shore by an inclined cradle that is used for carrying freight cars to and from the shore. The cantilever cranes with which each warehouse is equipped give service on one side to the car-float and on the other to the river-barge.

Carmine Sarno, Concrete Finisher

Billy Sarni at Work

In the news of the development of any industry we hear most about the executive whose genius for organization has built up a company of men, with operations so carefully synchronized and ably directed that we are unstinted in our acclaim of these successful captains of industry. Without the executive to direct the efforts of skilled men along various lines, the achievements would be slow, the results more or less haphazard and we would not get so far along.

On the other hand, we couldn't get anywhere with executives who sit at desks or go out on the job with white collars on, without men to handle the tools; carry out instructions; get the job done. Concrete wants to know about these men.

There is a certain aristocracy of overalls to which this magazine would like to give more attention. There are lots of men who attach a monumental dignity to a dirty-handed job, because they handle it with skill, tackle it with intelligent interest, and carry it through with painstaking care, with such pride in the result that the big executives couldn't possibly get along without them. For instance, here is a man best known as "Billy Sarni." He is the Aberthaw Company's oldest employee. He started as a laborer when the company was organized nearly 30 years ago. His right name is Carmine Sarno. He is not only the oldest but the best known employee and he is highly regarded as an excellent concrete finisher.

E. H. Temple, Jr., Aberthaw's construction manager, says that Billy has three hobbies: finishing concrete, raising children and growing grapes. He makes a success of all three. Regarding the first, the Aberthaw company believes that Billy is the best concrete finisher in the business and always puts him him in charge where a particularly fine piece of work is required. As for the second hobby, Billy's flock of eight speaks for itself. As for the third, Billy's home at Revere, Mass. is almost buried in grape vines and each year Billy finds his way to the Aberthaw office with several baskets of grapes of his own raising. Later on they are delivered in bottles.

Now who is there in your organization on whose skill and dependability you count a good deal to get the job done, whether in driving a truck, building forms, running a mixer, finishing a floor or any other one of the jobs that simply have to be done and have to be done right in order that the whole organization's achievement may actually be realized? Send us his picture, on the job and tell us about him.

The Value of Example

By James S. Frear

Mann & St. Lawrence Cement Brick Co., 20 Missinger St., River Falls, Miss., frame factory building destroyed by fire.

Not once but many times have such notices appeared in the columns devoted to the news of the concrete products manufacturers. In them is a valuable lesson that also appears every time a possible client looks at your place of business.

As a producer of concrete building units, you are urging a fireproof product. You believe in its ability to render a valuable building service; first in fulfilling a need for a permanent structure, and second, in the protection which it affords from both fire and weather. You talk this protection and value to every possible customer. It is the theme of your advertising. And then you nullify it all by continuing your manufacturing in a burnable building.

There is a greater advertising value in example than in all of the printer's ink that you can use. If a customer were to handle the matter properly he would stop your flow of commendatory language with the question: "If it's so good why don't you use it for your own buildings?" What would you be able to give him as an answer? It's worth thinking over.

The Weed tire chain has developed into a greater use because the company has given the dealer one phrase: "To sell 'em—use 'em." It is no empty phrase. In it is the business fundamental that you need. If you are really impressed that a concrete product is a worth while building unit; if you are manufacturing or installing concrete products because you are determined to render a definitely valuable service—why not tell the buying public all about it by using the product in the structure which houses either you or your business?

If the product is good enough for other people, and is good enough to make a living from, then it's good enough for you to back up both your business and your advertising by making every use of it that you can.

That's selling. It's selling by example. It's proving the value of your material through your own uses. It's the one means of definitely setting your place in the community. Let folks know where you stand—not by words but by example. "To sell 'em—use 'em."

How to Make Concrete Roof Tile

Certain of the instructions which the Crawfordsville Foundry Co. furnishes to users of its roof tile machines are of general application and should be of interest and value at a time when there is considerable activity in the concrete roof tile field.—*Editor*

In the selection of a sand for roof tile, it is necessary to consider the strength, curing, top coat, proportion of cement and the troweling qualities for rapid production. Always use washed sand. The dry sand should pass a screen having not more than a $\frac{3}{32}$-in. clear opening and in a horizontal position. The sand should grade evenly from coarse to fine. This grade is about the same as the No. 2.41 modulus test as outlined in Bulletin No. 1 (Structural Materials Research Laboratory) on design of concrete mixes. The test is inexpensive and quickly made and the method of calculating is as follows:

The sieves used are commonly known as Tyler sieves. Each sieve has a clear opening just double that of the preceding one. The sieve analysis may be expressed in terms of volume or weight. The fineness modulus of a sand is the sum of the percentage given by the sieve analysis divided by one hundred.

Size of Sieve	Size of square opening in inches	Percentage of sand coarser than given sieve
1½ Mesh	1.5 inches	0%
¾ Mesh	.75 inches	0%
⅜ Mesh	.35 inches	0%
4 Mesh	.185 inches	0%
8 Mesh	.093 inches	10%
14 Mesh	.046 inches	24%
28 Mesh	.0232 inches	46%
48 Mesh	.0116 inches	70%
100 Mesh	.0058 inches	91%
		241 div. by 100 equals 2 41 fineness modulus

The larger particles not only form a strong bond but also permit of the use of more water without slumping. A mix should be worked as wet as possible without slumping. The larger particles also have more of a rolling action under the tamping and troweling bar, and take the form of the bar much more quickly than a pasty or rubber-like material. The voids in the coarse sand give an opportunity for the top coat to be forced into the body of the tile. This is very important because the top coat will otherwise be only smoothed over or floated on and will not be an integral part of the tile. The taper or pressure angle of the bar is sufficient to force the top coat directly into the weather surface of the tile, provided it has a place to go; otherwise it will only be smoothed over and a part of it lost at the end of the head.

The additional water in the coarser aggregate will saturate a proportionately greater amount of top coat with no danger of slumps and thereby reduce the troweling of the top coat to one operation.

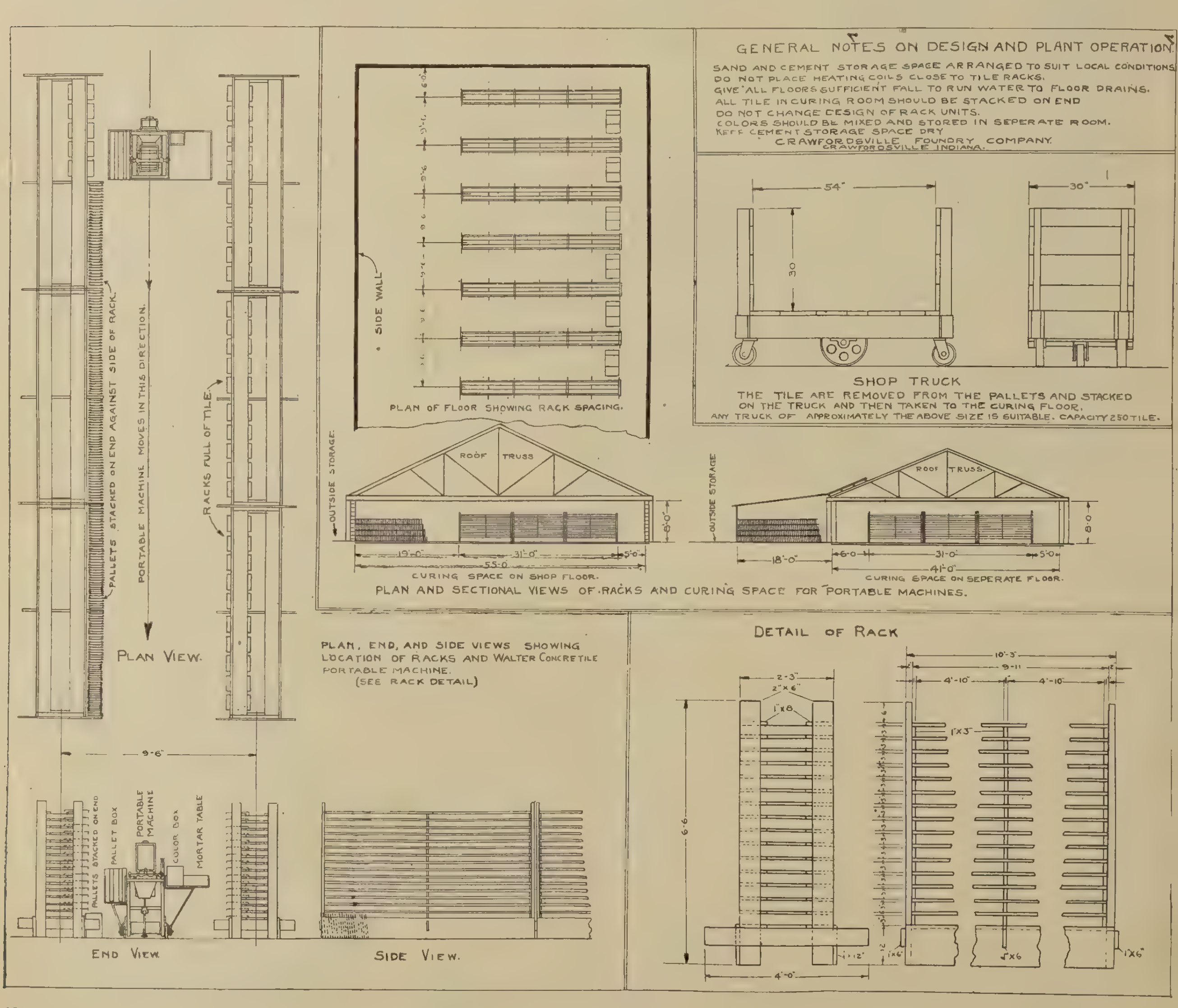

GENERAL NOTES ON DESIGN AND PLANT OPERATION.
SAND AND CEMENT STORAGE SPACE ARRANGED TO SUIT LOCAL CONDITIONS
DO NOT PLACE HEATING COILS CLOSE TO TILE RACKS.
GIVE ALL FLOORS SUFFICIENT FALL TO RUN WATER TO FLOOR DRAINS.
ALL TILE IN CURING ROOM SHOULD BE STACKED ON END
DO NOT CHANGE DESIGN OF RACK UNITS.
COLORS SHOULD BE MIXED AND STORED IN SEPERATE ROOM.
KEEP CEMENT STORAGE SPACE DRY
CRAWFORDSVILLE FOUNDRY COMPANY
CRAWFORDSVILLE INDIANA.
54"
30"
30
SHOP TRUCK
THE TILE ARE REMOVED FROM THE PALLETS AND STACKED ON THE TRUCK AND THEN TAKEN TO THE CURING FLOOR.
ANY TRUCK OF APPROXIMATELY THE ABOVE SIZE IS SUITABLE. CAPACITY 250 TILE.
SIDE WALL
PLAN OF FLOOR SHOWING RACK SPACING.
ROOF TRUSS
OUTSIDE STORAGE
8'-0"
19'-0"
31'-0"
5'-0"
55'-0"
CURING SPACE ON SHOP FLOOR.
18'-0"
6'-0"
41'-0"
CURING SPACE ON SEPERATE FLOOR.
PLAN AND SECTIONAL VIEWS OF RACKS AND CURING SPACE FOR PORTABLE MACHINES.
PALLETS STACKED ON END AGAINST SIDE OF RACK.
PORTABLE MACHINE MOVES IN THIS DIRECTION.
RACKS FULL OF TILE.
PLAN VIEW.
9'-6"
PALLETS STACKED ON END
PALLET BOX
PORTABLE MACHINE
COLOR BOX
MORTAR TABLE
END VIEW.
PLAN, END, AND SIDE VIEWS SHOWING LOCATION OF RACKS AND WALTER CONCRETE TILE PORTABLE MACHINE.
(SEE RACK DETAIL)
SIDE VIEW.
DETAIL OF RACK
2'-3"
2"×6"
1"×8
6'-6"
4'-0"
10'-3"
9'-11
4'-10"
4'-10"
1"×3"
1"×6"
1"×12"
1"×6

Fig. 1—Suggested Tile Rack Details, Plant Arrangement of the Racks, Pallets and Machines

Proportions of the Mix

The proportion of the mix depends entirely upon the grade of the aggregate. Our tests show that tile breaking at 200 lbs. with the load applied at the center of the long span are never leaner than 1:3 or richer than 1:2½. The 1:3 mix gives excellent results with the 2.41 modulus sand. The cement should be fresh and finely ground and thoroughly mixed with the sand before adding the water. Use a small batch mixer and add the water slowly until a small amount can be brought to the surface by striking the mix with the back of a shovel. Each tile maker should receive a fresh batch at least every 30 minutes and should have a small hand sprinkler to keep the mix tempered properly as he uses it. Never try to use a mix that has started to take the initial set.

Top Coat

The top coat waterproofs the weather surface of the tile and also colors it unless the natural grey is used. When making grey tile use the plain cement and do not add any other materials. When making red or green tile add enough color to secure the desired shade. This proportion is usually about 8 parts of cement to 1 part of color. The red color is iron-oxide and the green chromium-oxide. It is essential to secure absolutely pure oxides that contain no clay fillers or soluble salts which cause fading. Never experiment on cheap oxides, and after selecting a grade and brand do not change it.

A top coat should be ground to pass a 200-mesh screen and also be thoroughly mixed in a good color mill. Grinding alone is not sufficient. Unless the oxide, which has no adhesive properties, is thoroughly mixed with the cement it will become unseated and wash off the roof. Use 40 lbs. of top coat to 150 tile—one roofing square. Sift the top coat evenly over the weather surface of the tile beginning on the left hand side, and use plenty of pressure on the trowel bar.

Machine Operations

Each tile maker should oil his own pallets as they are used. Equal parts of kerosene and worn-out crank-case oil make a good lubricant. Never use a lubricant which is thick and gummy. Stack the pallet on end in the oil-drain and with the grooved side to the left hand side. As a machine is pulled down the aisle as the racks are filled the mix is delivered to the rear of the machine and placed on the mortar table, and at the same time the extra material in the wood tray is also placed on the mortar table and mixed with the fresh batch.

Curing

Tile should be left on the pallets from 18 to 24 hours. The time required for the initial set depends entirely upon the atmospheric conditions in the shop. The temperature in the shop should never be below 45° or above 65°. Always cure the tile in a moist heat and never in a dry heat. After removing the tile from the pallets stack them on end with the under side of the tile to the outside of the stack, and immediately saturate them with water and keep them in this condition for at least ten days before removing from the curing floor. After this is done a daily sprinkling or a fog spray system is all that is required. In curing room work, the steam must be saturated by passing it through water and the temperature held at not more than 65°, otherwise the tile will be spotted and show a lack of strength. Never try to steam cure tile while they are still on the pallets.

Removing Tile from Pallets

Within 18 to 24 hours after the initial set place the tile and pallet on end; vibrate the pallet on the back side with a light piece of metal. Any other method will result in breakage and fractured tile. Place the tile on a small truck and haul them to curing floor.

Stacking for Curing

As the tile are removed from the pallets stack them on end, because this keeps the material in compression, and not in tension. Always keep the bottom side to the outside of the stack. This gives the water an opportunity to penetrate the body of the tile.

Yard Stacking

Always keep the down end of the tile to the outside of the stack and when one row is complete paint the ends with top coat mixed with water. Use a large paint or whitewash brush for this work.

Uniform Product

After deciding on the proper mix, the grade of sand, the proportions of the top coat, etc., it is essential to keep using the same grade materials under exactly the same working conditions, for sometimes a very slight variation in manufacture will cause a noticeable difference in the quality of the tile.

Mollusks Damage Concrete Piers

A concrete-eating mollusk has been found to have done extensive damage to piers at San Pedro, Calif. This particular mollusk, called Pholas, is a bivalve, as are oysters and clams, and when fully grown is about three inches or less by one and a quarter inches.

When the piles were constructed a number of years ago they were jacketed with concrete to protect them from the common wood-borers. Recently it was found that the Pholas had bored through the concrete and so made way for the wood-borers to get at the wooden piles.

Just how the mollusk works is unknown.

The forward, rounded portion of the shells has a surface resembling a rasp or file. Whether, however, the cutting of the concrete or rock is due wholly to attrition with the rough shell, or whether it is aided by some secretion which softens the material, has not been definitely determined. These mollusks have been found in some hard rocks, but are generally found in shales.

Reports state that at every point in the inner harbor where mortar-jacketed piles exist, about 50% have been more or less attacked, of which more than one-fifth were badly bored, and of those not attacked a number were so far inshore as to be but little exposed. To allay unnecessary alarm, it should be said that the mortar was below average in quality, from 2 in. to 5 in. thick, some being decidedly poor. That these jackets had escaped attack for 14 years is attributed to the fact that the wooden forms used in depositing the mortar had been left in place. They were gradually destroyed by marine wood-borers.

Double Block

The "B. B." Hollow Block, produced by the B. B. Hollow Block Ltd., 262 Victoria St., Hamilton, N. Z.—this is really a two-piece block, the two parts, however, made together with metal ties. It is in many respects like the Anchor block, well known in the United States. It provides a continuous air space, and is made by a wet process, the dimensions of the block being 18 in. long, 6¼ in. high x 7 in. wide, including the cavity which is ⅓ the width of the block.

Graded Aggregate:

News, Review, Hearsay, Comment—A Department of Fragmentary Miscellanies—the material for which will be gathered from the job, the office, the factory, over the lunch table, in Pullman smokers, from the morning mail and many other sources.

Uses for Limestone Screenings

Limestone crushed to the consistency of sand grains may be used as a substitute for sand in mortar and wall plaster, according to the Department of the Interior, which has, through the medium of the Bureau of Mines, conducted a general study of the utilization of waste rock at lime plants. The superiority of crushed limestone over clean sharp silica sand is doubtful, but in regions where natural sand is scarce the substitution of a limestone product may be justified. Limestone screenings are used with success as fine aggregate in concrete for various purposes. Concrete brick, both common and face brick, are manufactured with limestone screenings as aggregate and are said to give satisfactory service in house construction. Limestone screenings without a binder are used for station platforms.

* * *

It is Folly for Any Man Going into Any Kind of Business to Fail to Take Full Account of the Probabilities of Success. Life insurance companies rate insurance on the basis of statistics which show that so many men die at such an age, so many more at such an age, and so on. Business mortalities have just such ominous statistics. An equipment producer in the concrete products field, in writing about the hazards in certain branches of the products manufacturing business, points out that they are not nearly so great as in many other lines. Where we see a great successful business, like the automobile business for instance, which has been doing unprecedented things in the last year, we look for success among automobile dealers. Yet this equipment dealer points out that a recent report of the National Automobile Association states that 10% of the dealers have made money, 25% have gone bankrupt and 65% have just barely managed to pay their bills. A man going into business, if he takes too seriously the probability of failure, hasn't the nerve to go ahead. He should, however, take that probability just seriously enough so that he doesn't go into business under any more precarious conditions than it is absolutely necessary for him to do. Orders do not come as soon as the wheels start to turn around, and if a man has only enough money to put up a building and equip it he might better stay out of business.

* * *

A Floor of Coral Aggregate, Green Color and a Minimum of Water

An unusual floor finish is being used in the new Bermudiana hotel at Hamilton, Bermuda, designed by Warren and Wetmore and being erected by James Stewart & Co., Inc., according to Thomas Moore of the Adensite Co., Inc. The floor finish is a 1:2 mix with crushed coral, which is obtained on the island, in place of sand. A Nile green color was called for. The contractors being desirous of assuring themselves of the right shade in a permanent form, several samples were experimented with. The final decision was for a mix containing 6 lbs. of sequi oxide of chromium (Cr_2O_3) to every bag of cement. As there is often considerable trouble with a green fading when a contractor goes into the market and simply asks for a chrome green, we think it will be useful, says Mr. Moore, for any contractor desiring this shade to remember the formula. A pure sequi oxide of chromium is light green in color. The adulterations have a dark shade. Mr. Moore says further in a letter to Concrete:

> The Bermudiana floor finish is being mixed with not more than 3 gals. of water to the bag batch.
>
> The requisite amount of coloring matter is held to a minimum by the use of a liquid integral compound that assures proper hydration of all the cement with a minimum water content. As there is no excess water used, no color is carried off and the positive solidification of the mass brightens the color effect.
>
> The integral compound in accelerating the set of the cement overcomes the retarding action of the coloring matter. The weakness generally experienced in colored concrete is overcome by the extra strength afforded by a regulated water content.

In response to Concrete's request for more detailed information, Mr. Moore explains:

> Cr_2O_3 is the formula for sequi oxide of chromium. Any color manufacturer will understand this formula. There are several reasons for the poor results from attempts to obtain green cement finish for floors. One reason is the contractor's method of marketing when he asks for a chrome green in the market. By narrowing down his color specification to a Cr_2O_3 for green he will, if dealing with an honest house, receive a 98% pure color. Another reason for poor color effects is an excess of water.
>
> Samples were made up for the Bermudiana hotel gauged with plain water and with Adensite and water. In the plain water samples the color effect was extremely weak with 8 lbs. of color to the bag of cement. In the Adensite gauged samples, the color was pronounced and pleasing with only 7 lbs. of color to the bag of cement. The same dry mix was used in each: 1:2 mix with coral aggregate. The plain samples were gauged with over 6 gals. of water to a bag batch, while the Adensite gauged samples required only 3 gals. of water to the bag batch. The percentage of Adensite was 1:12.
>
> A liquid integral composed of calcium chloride, resinous gums and carbons in proper solution will break down the surface tension of water. The duNouy test on distilled water, a 10% solution of Adensite and a 4% solution of calcium chloride shows the following averages:
>
> Water, 102.2; Adensite, 76.4; $CaCl_2$, 103.4.
>
> Breaking down the surface tension naturally gives a greater wetting. An integral such as Adensite also increases the flowability of the mix reducing the amount of liquid required for lubrication. The flow table test conducted by Professor Lapham shows an increase of 25 points in flowability in an Adensite mix over plain water. In a series of penetration tests for the workability of concrete mixtures, Adensite gave a compressive strength of over 2100, the highest in the series with a water-cement ratio of 0.94 and a workability of 54.
>
> As to a 1:2 mix: it has been my experience that the average architect specifies this for floor finish.
>
> I am convinced that grading of aggregates is not required if you reach all the cement in the mix with a minimum amount of liquid. This, of course, not only involves the hydration of the cement but the lubrication of the mass.
>
> In the concrete field, cement has been thoroughly studied, aggregates have been well considered and the quantity of the gauging liquid has, in very recent years, poked up its head for attention. There is one more point to cover—the quality of the gauging liquid.

Tests of Hollow Tile and Reinforced Concrete Floors

Sometime ago the Bureau of Standards conducted an investigation of the stresses in certain of the floor panels of the Arlington Building, Washington, D. C. This building was designed for use as a hotel, but was purchased by the Government and occupied by a branch of the Treasury Department. This change of occupancy considerably increased the live load which was taken care of by an additional layer of concrete on top of the floor panels. These panels are constructed of hollow tile and reinforced concrete supported on reinforced concrete beams. The tests are of unusual interest because they were among the first made on this type of construction and because of the provision above mentioned for carrying the additional load.

The test loads, consisting of bags of cement, were designed to produce the maximum positive and negative moments. Strain measurements were taken of the concrete and the reinforcing steel of the slabs and girders. In addition the deflections of the slab were measured, and it was found that the maximum stresses were developed at the positions of negative moment in the vicinity of the supporting beams. The beams at the edges of the panels offered so little resistance to torsion that the stresses in the steel across these beams due to negative moment, were but little affected by transfer of load between adjacent panels. While under load, the effect of time was very pronounced during the first 20 hours and comparatively small later. The increase in the deformation, due to continued loading, was greater in the reinforcement than in the concrete. The cracking of the concrete and the resulting great increase of the stresses in the reinforcing steel show that at first the concrete carried a considerable portion of the tensile stresses.

The moment coefficients were generally small, and the Bureau does not suggest them for use in design, but simply to show the relative amount of the bending moment carried in the two directions. The effect on the moment coefficient of an increase in ratio of length to width of the panel was a rapid increase of both positive and negative moments in the direction of the short span and a less rapid decrease of both moments in the direction of the long span. The factor of safety of the structure was apparently greater than 2. This investigation is described in Technologic Paper No. 236 of the Bureau of Standards which can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 15c a copy.

* * *

HIGHWAY ENGINEERS HAVE LEARNED THAT THE MOST IMPORTANT ATTRIBUTES OF PAVEMENTS ARE AN EVEN SURFACE AND AMPLE BEAM STRENGTH. Asphalt, brick, wood block, and cut stone are useful surfacing materials, but add very little strength to the pavement structure or to its ability to distribute concentrated loads over the necessary area of the underlying soil, comments the Portland Cement Association highway expert. Pavements—whatever the surface layers—are only as good as their foundations. A review of some sixty specifications from representative cities, large and small, shows that far less attention is required for the quality of the concrete foundation than for the surface layer. Almost anything in the way of materials is thought good enough for a concrete "base," except that the cement specifications are usually rigid, and rightly so. Yet the strength of the concrete will depend to a greater degree upon the amount (seldom mentioned) of mixing water used than upon the fineness to which the cement is ground. Not more than five specifications in sixty mention wetting the concrete during the hardening period, although this is one of the cheapest and simplest methods for developing strength. There is some tendency toward the use of 6-to 8-in. concrete bases, instead of the 4-and 5-in. thicknesses formerly thought adequate. But as long as mixing and placing methods are permitted which will produce concrete having a compression strength of only 500 to 1000 pounds per sq. in., there is little to be gained by increasing the thickness.

* * *

Facts and Fallacies in Monolithic Floor Laying

"The writer is a cement finisher, and writes from the point of view of the man who actually does the laying and finishing; and besides takes an interest to follow up the job to see how it stands up under the wear," writes Philip Weiss, Philadelphia, to CONCRETE.

"First I want to point out some of the fallacies of architects' specifications, then I will show the best and the most economical way of laying monolithic floors.

"The cinder fallacy: While there are some special occasions when a cinder base under a 6-in. floor is a necessity, some architects specify a cinder fill indiscriminately.

"On some jobs the specifications call for crushed stone without specifying the kind of sand to be used with it. Now, if the sand has not the same wearing quality as the stone, the floor will not wear well under a heavy traffic. In these parts where they use pebbles, mostly, the specifications usually call for ¾-in. aggregate regardless of the thickness of the floor.

"Some contractors make a practice of using a thick coat of drier. Apart from the fact that such floor is not monolithic, it is a doubtful practice, as the drier may not bind where the concrete is the least bid dry; besides, it encourages the slipshod laying of the concrete.

"To lay down a rule for the best practice of laying monolithic floor that will hold good under every condition is obviously impossible. However, there are some general principles which should be adhered to under all circumstances, and others as much as special conditions of the job will allow. To tell at a glance if the floor is laid right or not, observe the corners and edges; if the stones are not well embedded, either the finisher is not competent to lay monolithic floor or the mixture is not of the right proportion. If the stone separates from the mortar, cut down on the water.

"Monolithic should be of such consistency that it doesn't need to be tamped with a tamper; the judicious use of the rake and the straightedge will embed all the stone. In a 5-in. or 6-in. floor 75% of the aggregate should be 1½-in., provided there are no joints to cut. The floor should be in such a shape when laid that there should be no necessity for drier, unless the specifications call for a special finish.

"Last year I had occasion to patch a concrete road where there is a heavy traffic. The patches are from nothing to an inch thick. Now, after over a year, the patches are not even chipped. The main thing in patching concrete is to have the concrete rough, clean and wet. By wet I do not mean to wet it before patching, but to wet the concrete a day before if possible, and keep the concrete damp so that it will not absorb the moisture from the patch; and as soon as the patch sets up it should be kept damp for a few days."

POOR CAR TRACK CONSTRUCTION WILL VERY QUICKLY WRECK AN OTHERWISE FAIRLY WELL PAVED STREET. It is still the custom to require the traction companies to pay for the pavement in the track zone—another relic of a day long past, says *Concrete Highway Magazine*. The traction companies do not need the pavement—in fact, without a doubt they would handle more fares if the streets were unpaved! So why should they be assessed for a pavement, to say nothing of cleaning and sprinkling as is the case in many places? It would seem more reasonable to require them to lay trackway substructure and rails adequate for the loads, but to relieve them of the pavement cost. The nature of the trackway has an important bearing on the life and maintenance cost of the street surface above it, so there should be careful consideration of the trackway design by the municipal engineering authorities. It is entirely possible to pave a street, including the track zone, so that there will be a uniform surface from curb to curb; and the rails may be unnoticeable to vehicular traffic.

* * *

Insulation and the Coal Bin

The importance of the subject of heat insulation grows as our national coal pile diminishes. In an article by Mr. Burt in this issue one new insulating material is considered. What Mr. Burt has to say is chiefly in reference to frame construction. There are problems of insulation connected with concrete houses. Concrete walled houses have floors and roofs which, in most cases, probably for some time to come will be of frame. Even in the walls themselves, however, it is by no means certain that we are doing the best we can. We have been much concerned to make our walls to keep water out. It is important too, to keep heat *in* when it is wanted in and *out* when that is desirable. Is the furred and plastered wall the best thing available for the purpose? Or is the continuous hollow space best? We seem to be on the brink of discovering that perhaps extreme density of concrete is not the best thing in walls that are to possess the greatest heat insulating value. Years ago this magazine published some references to the virtues of a kind of "popcorn concrete"—something like the result which cinders provide. Mr. Burt's discussion gives insulating values for concrete (1 in. thick) not very pleasing. Obviously the tests cover dense concrete. Density, it seems, is not the most desirable characteristic for *all* purposes. Can we have sufficient strength and sacrifice a good deal of that quality? The answer is undoubtedly *yes*. Insulation is worth while considering from new angles. The hollow block and the double wall are not perfection in themselves.

* * *

CONCRETE TANKS FOR THE STORAGE OF BENZENE can be made impermeable by lacquering the inside wall with a new preparation called Margalit, according to a Berlin correspondent. The material is applied in the same way as oil color. Through oxidization and polymerisation it is said to form an inseparable connection with the concrete and become very hard. Concrete walls thus treated are said to be unaffected by all oils, benzene, naphtha, coal-tar, etc.

* * *

Granite Monuments and Granite Concrete Burial Vaults

The Terre Haute Monument Co., of Terre Haute, Ind., finds that the manufacture of concrete burial vaults from its waste granite is a very profitable side line. Lynn H. Hollis of the Terre Haute Monument Co. says that monument dealers and granite manufacturers in the Middle West are frequently handicapped in using Barre granite on account of high freight rates and considerable waste in cutting. Not only has the burial vault business developed satisfactorily in itself and produced good return, but by means of the burial vault business, the company has been able to reclaim a large percentage of profit that was formerly represented by a pile of granite spalls.

The original Norwalk vault molds were purchased in 1914 and after one or two false steps in getting the business started on the right basis, a new start was made in 1917, manufacturing a superior article, with personal calls upon undertakers and by local newspaper advertising. In 1917 the company sold 66 vaults; in 1918, 133 vaults; 1919, 165; 1920, 272; 1921, 207; 1922, 297.

* * *

HOW SUGAR AND OTHER ORGANIC MATTER, EVEN IN VERY SMALL QUANTITIES, are influencing the setting and the ultimate quality of concrete, is told by Dr. Hundeshagen in *Zement*. It had been observed that a concrete floor in a sugar factory was not setting, though the mortar had been prepared in the ordinary way in a proportion of 1 part of cement to 3 to 4 parts of gravel and sand, and the work had been conducted with the usual precautions. It was noticed that three-quarters of the concrete which had been mixed first was not binding. The surmise that, in spite of the careful preparation, some sugary substance had been mixed up with the concrete, was confirmed by experiments. It was found that the content of sugar in the bad concrete was 0.06 to 0.08% in the mortar or 0.3 to 0.4% in the cement. Further tests proved that even 0.1% of sugar in the cement, equal to about 0.02% in the mortar, was disturbing the setting process. With 1% sugar in the cement, equal to 0.2% in the mortar, setting was very slow and the concrete was crumbling if slightly shaken.

An addition of 5% of sugar to the cement or 1% to the mortar seemed at first to give better results. The setting appeared to progress normally. After a time, however, white efflorescence became visible. The outside appearance was that of ordinary concrete, but a slight stress broke the test piece, and showed that it was soft and cracked inside. All the test pieces containing sugar gave a hollow sound when tapped with a hammer.

* * *

How to Make Lime Set Quickly

Some months ago, the Bureau of Standards developed a quick setting lime composed of 1 volume of ground quick-lime and 2 volumes of hydrate. The commercial success of this material depends upon finding some way to make it keep during shipment, or else to make it into finished form at the factory. Working on this latter phase of the subject, the Bureau has been developing a cast lime partition tile. Experiments have shown the best composition to be 1 volume of wood fiber, 5 of quicklime, and 10 of hydrate; and that the best curing condition is outdoors exposed to the weather. Such a block sets so that it can be removed from the mold in 10 minutes, can be handled in 20 minutes, can be sawed and nailed, and has a compressive strength of 100 lbs. per sq. in. at 7 days. It is about 20% heavier than gypsum tile of the same size, and experiments are now being conducted to see if the core volume can be increased without too great a sacrifice of strength.

A CONFERENCE OF THE SECRETARIES OF NATIONAL INDUSTRIAL STANDARDIZING BODIES WAS HELD IN SWITZERLAND, JULY 3 TO 7. Thirteen countries were represented, including all of the more important industrial nations of Europe and America. The sessions were held in Zurich and in Baden. A leading topic discussed by the conference was the interchange of information between the various national bodies during the development of the work in the different countries. At the first conference held in London two years ago, arrangements were made for the systematic interchange of completed work and, to some extent, of information on work in progress. Experience had shown such an early interchange to be extremely important for the work within the different countries, from the national viewpoint alone and quite irrespective of the question of international standardization.

The conference was attended by the following delegates:

AUSTRIA, Austrian Standards Committee for Industry and Trade, Jaro Tomaides; BELGIUM, Belgian Association for Standardization, G. L. Gerard; CANADA, Canadian Engineering Standards Association, R. J. Durley; CZECHOSLOVAKIA, Czechoslovakian Standards Society, B. Rosenbaum, R. Matousch, F. Kneidl; Masaryk Academy of Labor, Standards Committee, Jan. F. Kottland; FRANCE, Permanent Committee for Standardization, Eug. Lemaire; GERMANY, Standards Committee of German Industry, W. Hellmich; GREAT BRITAIN, British Engineering Standards Association, C. Le Maistre; HOLLAND, General Committee for Standardization in the Netherlands, J. Goudriaan; ITALY, General Committee for Standardization in the Mechanical Industries, Renzo Curti; NORWAY, Standardization Committee of the Norwegian Industrial Association, Alf. Erikson; SWEDEN, Swedish Industrial Standardization Committee, Amos Kruse; Swedish Machine Industries Association, E. Fornander, H. Tornebohm; SWITZERLAND, Standards Federation of the Association of Swiss Machine Industries, H. Zollinger; UNITED STATES, American Engineering Standards Committee, P. G. Agnew.

* * *

Stucco Investigation

For several years past, the Bureau of Standards has been studying stuccos, and many of its findings have been embodied in a "Recommended Practice for Portland Cement Stucco" which was formally adopted recently by the American Concrete Institute as one of its standards. The practice covers the application of stucco to all bases, and although a masonry base is probably capable of giving the most dependable results, it is recognized that there has been and probably will be for many years to come a larger use of stucco on frame houses than on masonry structures.

The application of stucco to frame houses involves greater uncertainties in results than on masonry bases, and in order to solve some of these problems, the Bureau proposes to carry out, in cooperation with some of the interested trade associations, a study involving about 30 test panels on the stucco test building. Considerable interest has been shown in this work, and a conference will probably be held in the near future. If the full cooperation of the interests involved is secured, it is planned to start work early in the Fall.

* * *

The Effect of Accelerators on Reinforcing Steel

A number of 1:2:4 concrete and 1:3 mortar specimens in which steel rods have been embedded were broken recently by the Bureau of Standards, and an examination made of the rods. Calcium chloride solutions had been used for some of the specimens as the gauging liquid. An examination was also made of expanded metal which had been embedded in small slabs prepared from mortar gauged with a proprietary compound of the accelerator type.

Some of the foregoing specimens were 5 and others 6 years old and all had been stored out of doors and exposed to the weather. From this examination, it is concluded that while calcium chloride tends to corrode the reinforcement, the corrosion does not seem serious or of a progressive nature with age, in cases where the reinforcement is completely embedded in the concrete. However, when using accelerators care should be taken to completely coat and embed the reinforcement and avoid pockets near it. The strength of the specimens which had been exposed to the weather was considerably higher when calcium chloride had been used than when it had not been employed. Sufficient specimens remain to allow another examination at a later date, and a comparison of the rod condition and strength will be made at different ages.

* * *

THE 1924 CONVENTION AND ROAD SHOW OF THE AMERICAN ROAD BUILDERS' ASSOCIATION will be held simultaneously in Chicago the week beginning January 14 next. The convention headquarters are to be in the Congress Hotel, and the road show will be held in the Coliseum and the adjoining Greer Building. Frank Page, president of the American Road Builders' Association, has appointed Charles M. Upham manager of the convention and road show. Mr. Upham will report directly to the executive committee of the American Road Builders' Association. With the approval of that committee, Mr. Upham will appoint several committees to handle various features of the two big events of the year in the highway industry.

* * *

Penetration Tests for Workability

The Bureau of Standards has recently completed the laboratory work in connection with the development of a penetration test for the workability of concrete mixtures, and a paper has been prepared and approved for publication. This describes the penetration test for measuring workability as distinguished from consistency or flow. If workability is defined as that property of a concrete mixture upon which depends the amount of work required to handle and distribute the concrete uniformly, the indications of the test seem to be correct.

The outstanding results obtained from the penetration test in this investigation are: (a) The relative effects of celite, kaolin, hydrated lime, and other admixtures upon the workability of the concrete have been determined; (b) the workability of concrete mixtures varies only moderately with change in consistency or flow and is more dependent upon the character and proportions of the solid ingredients than upon the quantity of mixing mortar; (c) the workability of concrete mixtures shows a maximum of medium wet consistency; (d) the workability of concrete mixtures depends upon two factors, segregation and lubrication, either one of which may be controlled by suitable changes in the ingredients of the concrete.

* * *

RUDOLPH P. MILLER, consulting engineer of New York city, the representative of American Engineering Council on the National Board for Jurisdictional Awards in the Building Industry, was elected chairman of that board at its recent meeting in Atlantic City, New Jersey.

Pittsburg Road Tests

The methods and results on the Pittsburg, Calif., test highway have just been published in an official report.

The plain concrete designs which provided ribs or thickened edges were proved to be amply heavy to withstand almost completely the effects of traffic, and thus they establish an upper limit for designing such plain concrete slabs. The possibility of lightening these designs and the possible advantage of introducing some reinforcing in the curbs, need further study.

A survey of the crack records for the various sections shows that in most cases the start of the failure was at one of the ends of a section, and usually at that end of the section from which the trucks approached. Also, numerous breaks started at the corners and edges adjacent to cracks.

With the same number and weight of trucks being operated during the day and early morning, there was a decided increase in the number and extent of cracks forming in the pavements during the early morning traffic over those in the daytime.

The record of cracking prior to applying traffic shows the persistence of transverse temperature cracks. It is noteworthy that no longitudinal cracks occurred in those sections with full transverse reinforcing but that such cracks did occur in all the plain concrete slabs with inverted curbs or thickened edges and that no longitudinal cracks occurred where longitudinal joints were used in the reinforced sections or in the plain concrete sections with submerged curbs. Apparently without transverse reinforcing and without longitudinal joints, the curbs or thickened edges, by reason of their anchoring action, tended to cause longitudinal cracks which might be avoided by such longitudinal joints or probably by sufficient transverse reinforcing. The record of cracking also shows that, after cracking, the broken areas of the heavily reinforced sections (C, D, K and L) were held together by the steel and doubtless their final breakup retarded.

The phenomenon of edge curling of pavements due to daily changes in atmospheric temperature is now well established, for the Pittsburg tests check with the observations at the Bates test road in Illinois and with those at the Arlington, Va., tests by the Bureau of Public Roads. The maximum observed upward curling of an edge during the cool hours of the night was .08 of an inch and curling occurs at all boundaries and is most pronounced at corners. There is some indication that the amount of temperature curling was increased in the thicker slabs, as particularly in Section I after rebuilding 8 in. thick, but it is not known whether reinforcing had any effect in this respect. When the regular traffic was applied in the early morning the cracking was noticeably accelerated.

It seems difficult to give the thirteen types of pavement a final explicit rating of performance under the Pittsburg conditions. Their relative condition with respect to cracking and to disintegrating areas is not difficult to compute nor is their theoretical construction cost. The relative cost of maintenance because of the impossibility of applying maintenance at the right time and because of no prearranged agreement as to its measure, is a more difficult item to use in rating the pavements. However, in the discussion the engineers in charge of the test have submitted a table including calculated maintenance costs per mile during the test as part of the computed total costs in presenting the pavements ratings, which ratings however can not include the relative effect on operating costs due to the condition of the various sections and do not include interest on the original investment. The cost of construction here tabulated is necessarily based on the actual thickness of each section as measured in the field, not on the designed thickness.

By this table, the computed total cost of Section J which proved to be 6.9 in. plain concrete with the outer 2 ft. thickened gradually to about 9 in., was the lowest of all. Its service to traffic was unchanged from the beginning and there were practically no more indications of disintegration than appeared when the road was thrown open to traffic. It cannot be overlooked that if the expenditure for reinforcement used in all of the heavily reinforced sections had been applied to additional thickness of concrete, then the resulting plain sections would all have been thicker than Section J.

The stress produced by loads applied at the boundaries of the slab is relatively important, especially near

TABLE 17

Comparative Pavement Ratings, June 30, 1922. Traffic Over Test Highway to June 30, 6,914,850 tons.
(Note: See Table 12 for actual thickness.)

Section	Cubic yards of concrete per mile as actually laid	Tons of steel, per mile	Total broken areas in square feet per square yard of pavement	Total lineal feet of cracks per square yard of pavement	Computed original cost per mile of pavement only	Theoretical maintenance cost per mile	Percentage of failure	Total computed cost maintenance plus original cost per mile	Unit comparison of total computed cost per mile
J........	2,110	....	0.07	1.44	$31,439	$ 885	2.8	$32,324	1.000
D........	1,845	55	0.36	2.01	33,271	4,205	12.6	37,476	1.159
C........	1,798	55	0.45	2.56	32,549	5,152	15.8	37,701	1.166
K........	1,722	69	0.53	2.66	32,643	6,049	18.5	38,692	1.197
F........	2,719	....	0.00	1.11	39,426	117	0.3	39,543	1.223
M........	2,574	....	0.22	0.70	37,323	2,810	7.5	40,133	1.242
E........	2,806	....	0.00	0.60	40,687	63	0.2	40,750	1.261
G........	2,127	69	0.56	2.04	37,902	7,291	19.2	45,193	1.398
L........	1,740	55	1.56	2.29	31,659	16,705	52.8	48,364	1.496
B........	1,590	20	2.99	3.91	26,207	26,534	100.0	52,741	1.632
H........	1,760	24	3.09	3.91	29,176	30,464	100.0	59,640	1.845
I........	1,953	24	3.12	3.01	32,139	33,743	100.0	65,882	2.038
A........	1,834	20	4.08	3.74	35,427	48,576	100.0	84,003	2.599

(a) All pavements 18 feet wide.
(b) Estimated Cost—
    Unit costs of plain concrete as follows:
        From 1,001 cubic yards to 1,500 cubic yards per mile $15.75 per cubic yard.
        From 1,501 cubic yards to 2,000 cubic yards per mile $15.35 per cubic yard.
        From 2,001 cubic yards to 2,500 cubic yards per mile $14.90 per cubic yard.
        From 2,501 cubic yards to 3,000 cubic yards per mile $14.50 per cubic yard.
    Cost of reinforcing steel, $90.00 per ton in place.
    Cost of rock ballast under Section A, $5,475 per mile.

(c) Cost of maintenance of cracks assumed equal to one cent per lineal foot. Unit maintenance costs of broken areas are assumed to be three times the original unit cost of the pavement only.

(d) Percentage of failure determined from ratio of sum of maintenance costs to original cost. Those cases where maintenance cost exceeded original cost, percentage of failure is 100.

the end of slabs, since tension and cantilever strain may occur at the hours of greatest upward curling where the slab edge and end may be entirely unsupported. It is apparent by study of the crack record diagrams that the slabs failed first and probably almost invariably from the ends and edges inward. There is opportunity for much more study here especially to determine if deflections under suitably timed successive moving loads become cumulative in effect and if the ribbed slabs resist deflection. It is also desirable to know if tension occurs alternately in the top and bottom of the slab and in which direction such tensions are or tend to be greater. It is noticeable that all the many impact tests with 9280 lbs. on the rear axle, dropping a maximum of 2 in. with maximum deflection of .08 in. did not in a single recorded case produce immediate visible cracking. The transverse bending or deflecting effect observed under such impact tests varied roughly in proportion to the severity of impact and indicated considerable elasticity in all the slabs tested. Joint irregularities and broken areas on the other hand produced a kind of continual impact that ultimately destroyed areas of the pavement with sufficient regularity to establish this phenomenon beyond question; namely, that repetition of regular heavy traffic blows in great numbers will necessarily disintegrate almost any slab, particularly where flexure occurs. The very strong section M failed at one corner as a result of repeated blows of traffic following the disintegration of the adjoining corner of Section A.

There is ample evidence in the results of the Pittsburg test that repeated extensive flexure and cracking are associated. Cracking, for example, habitually starts where flexure is greatest. The amplitude of such flexure was relatively large; under the greatest moving loads used (about 22 tons) it was one-tenth of an inch and this flexure itself was not visibly harmful. Repeated flexure was visibly harmful. All the tunnel records showed that the amplitude of the flexure tended to increase as the total traffic increased. With allowance for cracking there is still in this record an added indication of the association of increasing weakness with greatly increased numbers of flexures. There is little if any evidence that the heavy reinforcement as distributed prevented such flexures, but it unquestionably, as stated above, retarded disintegration.

Hot Water Mix in Warm Weather

A correspondent wants to know the probable effect of using hot water for mixing concrete in warm weather. He doesn't say why.

Tests which were made at the Structural Materials Research Laboratory, Lewis Institute, and reported in Proceedings American Concrete Institute, vol. 14, 1918, p. 20, showed that the temperature of the mixing water had no appreciable effect on the strength of the resulting concrete at ages of 7 days to 3 mo. Compression tests were made on 6 x 12-in. concrete cylinders of 1:4 mix by volume. The concrete was mixed for 4 different consistencies: relative consistency 0.90, 1.00, 1.10 and 1.25. The temperature of the mixing water ranged from 32° F. (ice water) to 212° F. (boiling water.) Specimens were stored in damp sand until tested. The data are given in the appended table.

The results for the four consistencies were quite similar in showing that the temperature of the mixing water produced no appreciable effect on the strength of the concrete. All materials in these tests, except the mixing water, were at room temperature. The temperature of the concrete was raised about 1° for each 5° rise in temperature of the mixing water.

Prof. Duff A. Abrams says he would not expect that the use of hot water for mixing in warm weather would have any appreciable effect one way or the other, especially if the concrete were cured in a proper manner, and that the effect on the water-ratio due to water which evaporates is somewhat problematical. It is his belief that it is only the water which evaporates (or is removed in some other way) during the first hour or two after the concrete is placed (and before initial setting begins) that has any influence in reducing the water-ratio of the concrete.

EFFECT OF TEMPERATURE OF MIXING WATER ON THE STRENGTH OF CONCRETE
(Series 97)

Compression tests of 6 x 12-in. concrete cylinders mixed 1:4 by volume. Each batch mixed 1 min.—18 revolutions. Mixing was begun after all materials were in the drum. Cylinders made in steel forms and stored in damp sand; tested damp. Each value is the average from tests of 10 cylinders from two batches. The average temperature of the aggregate varied from 11 to 13°C.; the average atmospheric temperature of the room in which the mixing was done was 12 to 15°C.

Temperature C°		Compressive Strength—lb. per sq. in.		
Mixing Water	Concrete	7d.	28d.	3m.
Relative Consistency 90%—Water .68 of Volume of Cement				
0	12.9	1550	3460	4840
10	14.0	1660	3400	4900
20	15.8	1540	3360	4820
30	17.6	1790	3640	4990
40	19.4	1790	3480	4810
50	21.8	1640	3400	4660
60	21.5	1780	3540	4940
70	24.2	1820	3520	4960
80	26.0	1830	3580	4760
90	28.0	1960	3420	4560
100	29.8	1760	2990	3900
Av.	21.0	1740	3440	4740
Relative Consistency 100%—Water .76 of Volume of Cement				
0	11.2	1280	3170	4620
10	13.0	1220	3040	4400
20	15.5	1250	3080	4380
30	17.8	1260	2990	4390
40	20.0	1380	3070	4560
50	22.2	1420	3200	4500
60	24.0	1360	3220	4450
70	27.0	1340	3130	4320
80	28.4	1340	3070	4210
90	30.0	1580	3160	4080
100	31.8	1720	2920	4460
Av.	21.9	1380	3100	4390
Relative Consistency 110%—Water .83 of Volume of Cement				
2	9.5	1000	2720	4300
12	11.8	1060	2780	4220
22	14.5	990	2680	3920
32	17.1	1100	2640	4000
42	19.9	1160	2580	4320
50	22.2	1020	2760	4050
60	24.0	1040	2640	4000
70	26.5	1110	2860	4200
82	31.1	1100	2590	3950
90	31.0	1220	2700	3830
100	34.8	1500	2980	4270
Av.	22.0	1120	2720	4100
Relative Consistency 125%—Water .95 of Volume of Cement				
0	10.5	900	2320	3700
10	11.8	820	1970	3290
20	15.2	780	1770	3200
30	17.2	920	1990	3440
40	20.5	980	2080	3540
50	23.4	1080	2310	3640
60	26.4	1050	2390	3560
70	29.2	1020	2260	3520
80	31.5	920	2160	3260
90	34.8	980	2400	3360
100	34.6	980	2160	3390
Av.	23.2	950	2160	3450

June 12, 1923

For increasing the resistance of cement to sea water, the addition of pulverized sand instead of trass to blast furnace slag cement, is advised by Grun, inasmuch as the sand would give the same results and cost less than the trass. There are other factors which affect the compactness of the cement exposed to the action of sea water and more particularly colloidal action, which is entirely lacking in sand.—*Chemical Abstracts.*

Fordson With Shovel Handles Gravel for Products Manufacturer

The accompanying pictures show unusual material handling methods used by Harry B. Cooper, concrete products manufacturer at 28th and McClelland ave., Erie, Pa. Fig. 1 shows removal of top soil; Figs. 2 and 3, loading top soil onto dump wagon; Fig. 4, using top soil for filling and Fig. 5, hauling washed gravel from washer to block plant. Mr. Cooper says:

I find this method to be practical and much more economical than using teams, as it does not represent a very large investment, and requires no attention when not in use.

The tractor is a Fordson, cost $425. The shovel is made by the Lessmann Loader Co. of Des Moines, Ia., cost $250. It is raised by power, operated by a lever and clutch works to perfection, and I would not hesitate in saying that it will shovel more gravel than six men in the same length of time.

My block plant is about 500 ft. from gravel washer; by having it that far away it gives plenty of room for storing blocks on level ground and I consider it cheaper to haul the washed gravel from washer to block plant, than to convey all the unwashed gravel to the washer and have it close up to the block plant.

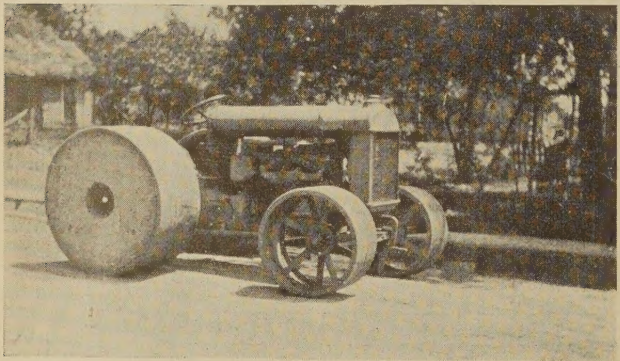
The pit covers about six acres at a depth of from 6 to 18 ft.; the washer is built on heavy sills so it can be moved to any part of the pit.

This is the first year I have operated and have started with one unit, consisting of Hobbs block machine Anchor tamper, Kent mixer and electric drive.

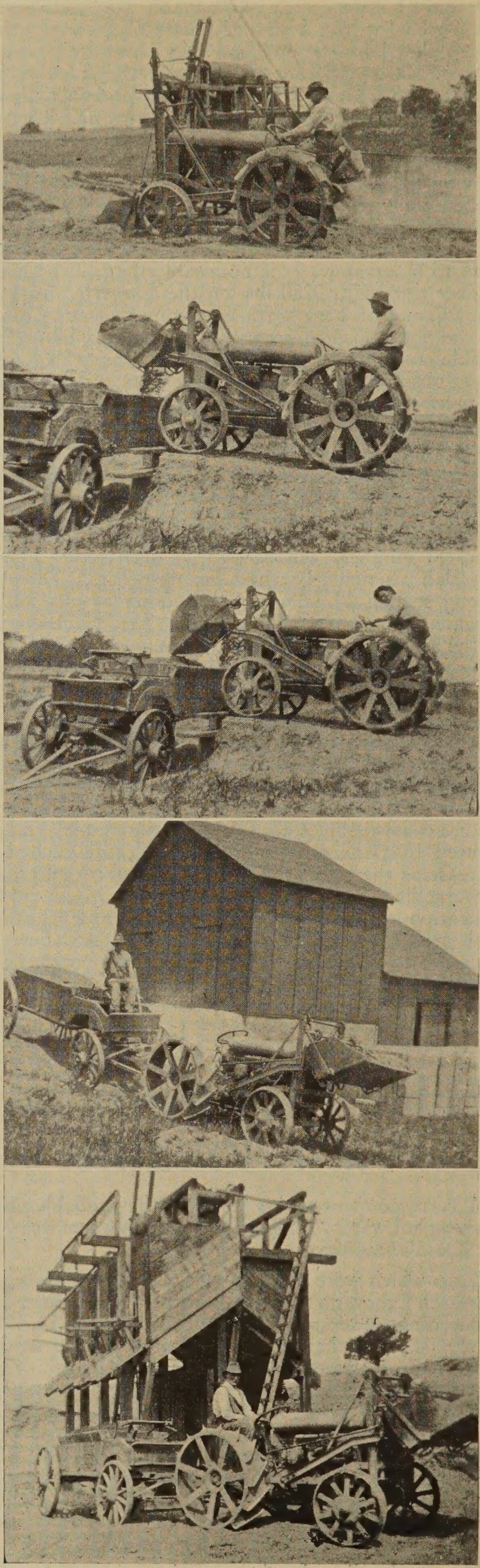
The gravel is dumped into a chute at front of building and drops to basement; it is then lifted by a bucket elevator to bin over mixer, which stands 6 ft. above block machine feeder, so it is just a gravity proposition which does away with a lot of hand labor. The cement is stored on a platform level with mixer hopper, which makes it very easy to feed.

The block plant is 30 ft. x 30 ft., to which I have recently added a curing room 30 ft. x 40 ft. Curing room has a 4-in. concrete floor as I intend to install racks and lift trucks.

Small Tractor Is Changed Into Efficient Road Roller



By removing the original wheels of a Fordson tractor, substituting golf course wheels, and filling the extension rims with concrete, Mautz & Oren, contractors, Effingham, Ill., with the help of W. F. Eakin made a light roller that is proving very serviceable to them in their road-building work. This strange little machine has some distinct advantages over the heavy steam and horse rollers. With the concrete filling added, the weight of the tractor was brought up to about 5,000 lbs. The front wheels have 14-in. treads and the rear wheels 20-in. treads. One advantage that this converted tractor has over the heavy steam roller, is that with its use there is no need for keeping up steam all of the time; this roller is ready for service at any time. Furthermore, it is very easy to handle on road work and does not fill a lot of valuable or needed space. It has been found that this lighter roller leaves a much smoother surface than the heavier steam roller.



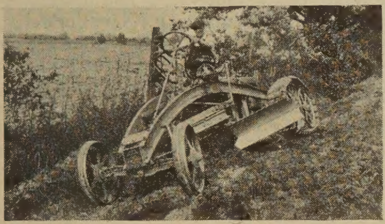
Figs. 1 to 5 (Top to Bottom)—Removing Top Soil and Hauling Gravel for Concrete Block Plant, Erie, Pa.

Rustic Urns

Urns Surfaced with Rock Fragments

The A. T. L. Rustic Co., Belvidere, Ill., issues a circular illustrating and describing rustic vases, porch boxes, bird baths and sun dials, made with an extremely coarse facing treatment of rock fragments and almost entirely devoid of mortar on the surface. A sample of the work is shown in the accompanying illustration.

Fordson Converted Into Crawler



Converted Tractor on Road Job

Rigid Rail Tracks for Fordson Tractors is the subject matter of literature put out by the Hadfield-Penfield Steel Co., Bucyrus, Ohio, showing how power may be added to Fordson tractors by the use of crawler equipment, for road work, snow cleaning, plowing and various farm jobs and in the lumber camp. With attached equipment, the rigid rail tracks convert the Fordson into a crawler tractor. One utilization of the combined Hadfield-Penfield Steel Co. equipment is shown in the accompanying illustration.

Colormix

Colormix is a new compound which gives color to concrete floors in the mix. It is put out by the Master Builders Co., Cleveland, Ohio, as a paste with about the consistency of which lead. When put into use it is dissolved in the gauging water where it dyes the sand and the cement. It is said also to increase the concrete's tensile and compressive strength, render the material waterproof, produce an attractive floor at a low cost. It can be used in making concrete tile, colored all the way through, according to the the announcement of the producers. It comes in the following colors: tile red, battleship gray, linoleum brown and Nile green. It can be used, it is said, at a cost per sq. ft. of 1-in. topping of 6c to 8c for the red, 2c to 3c for the gray, 6c to 8c for the brown, 50c to 60c for the green.

Larger Jaeger Mixer

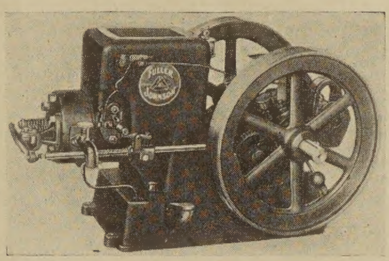
No. 14-L, 14 cu. ft. of *mixed* concrete capacity per batch is the newest addition to the Jaeger line of concrete mixers, on the same lines as other Jaeger models, Jaeger Machine Co., Columbus, Ohio.

While the 14-L is a model new to the trade, it has been given a thorough workout under severe conditions of service for more than a year and has been adopted as a standard Jaeger unit. Drum is standard Jaeger tilting type for quick loading and discharging; drum 52 in. in diameter and 44 in. deep; engine—4 cylinder 15 h. p. automobile type, built for heavy duty; large loader bucket. Lifted to unloading position by quick-acting cone clutch—equipped with brake for perfect control. Water tank, Jaeger tip over tank, ample size for full capacity wet batch. Simple, automatic in action.

New Bricklayers' Trowel

The Mann Patent Trowel, put on the market by the M. P. Trowell Agency, 213 Hudson St., Indianapolis, Ind., is a new kind of tool for bricklayers. It is really a scoop, with the idea of greatly speeding up bricklaying, making it possible, the producers say, for a beginner to do good, rapid work.

New Model 2½-H. P. Engine



New Model 2½ H. P. Engine

The illustration shows a new model, Fuller & Johnson Mfg. Co., Madison, Wis., 2½ H. P. Model "N" gasoline engine. This size, as well as others in the line, has the following improvements: A new filler pipe to the fuel tank makes it easy and convenient to take care of the filling operations; a double throw switch to assure uninterrupted service; new magneto mounting, safe from oil and grease; wide, heavy fly wheels and heavy crank shaft, for strength and rigidity.

For Patches

Quickfix is a compound put out by the Master Builders Co., Cleveland, Ohio, for repairing concrete floors so as to produce a patch of great hardness in 48 hours. In 24 hours, it is said that the strength of a Quickfix batch of concrete if 71% greater than that of ordinary mixtures.

Jaeger Also Builds 14-P Paver

The new 14-L Jaeger mixer has been built into a new Jaeger paver No. 14-P. A complete Fordson 4-cylinder engine, with differential gear has been adopted as the power unit for the 14-P.

A new cement bag cleaner is described in a 4-page folder issued by Joseph Wirth Co., manufacturers, Fond Du Lac, Wis. Distinctive features claimed for the Wirth bag cleaner include a saving of approximately 600 to 700 lbs. of cement per 1000 bags cleaned; ability to clean any kind of bag; capacity 150 bags per hour; requires attention only when bags are placed in the machine and when they are removed. The cleaner stands up so that the floor can be kept clean under it. The cleaner is equipped with tight and loose pulleys or equipped with ½ H. P. electric motor ready to connect to any lamp socket.

Trade Publications

"Duro" Pumps and Water Systems for City, Suburban and Farm Homes is the title of a catalog of the Duro Pump & Mfg. Co., Dayton, Ohio; 40 pages and cover, with detailed descriptive matter, specifications and illustrations on various water system units for different conditions of supply.

Blaw-Knox Flat Slab System for Building Construction, Bulletin No. 211, the Blaw-Knox Co., Blawnox, Pa.; 20 pages including cover, 7¾ x 10¾ in., describing and illustrating the use of Blaw-Knox flat slab floors and also Blaw-Knox column forms, wall forms, and the Blaw-Knox removable pan system for ribbed slab floors.

Equipment for Contractors, 32 pages and cover, railroad time-table size, issued by the R. E. Brooks Co., 50 Church St., New York city, listing and illustrating examples of equipment and the follow-up service of mechanics and engineers which is maintained to assure a contractors' service station in the construction field.

Type AA Reliance Induction Motors, Bulletin No. 5018, 8½ x 10 in., 16 pages and cover, of the Reliance Electric & Engineering Co., Cleveland, Ohio, presenting attractively in text and pictures the uses of Type AA Reliance induction motors with two and three phase alternating current circuit, and the story of their development.

Ambler Asbestos Building Lumber, a catalog descriptive of applications of products made by the Asbestos Shingle & Sheathing Co., Ambler, Pa.—two types of wallboard for exterior and interior use, of fireproof material, being made of portland cement and asbestos fibre. Asbestos building lumber comes in various thicknesses, ⅛ in. to 1 in., at variations of ⅛ in., in sheets 42 in. x 48 in. and 42 in. x 96 in. It is employed very extensively as an outer wall covering to produce half-timbered effects in residence and other construction, with an appearance like smooth stucco. The same producers make Linabestos, which is not recommended for exterior use but is used chiefly for interior work such as paneling, lining of closets, kitchens, cellars, attics and other places where a fireproof wallboard is wanted.

Blaw-Knox Removable Pan System for Ribbed Slab Floors, Bulletin No. 210 of the Blaw-Knox Co., Blawnox, Pa., Pittsburgh District; illustrating and describing in detail, in use on the job, metal pan system for floor construction with concrete, detailing the use of the metal pan unit.

Alpha tile products and the methods used in making them are described in a circular issued by the Alpha Tile Co., 30 Church St., New York city. The company owns patents covering the manufacturing process on this particular type of decorative tile for which licenses are given. There are said to be seven plants operating at this time: Los Angeles, Calif., Portland, Ore., Seattle, Wash., Tulsa, Okla., Oklahoma City, Okla., Kansas City, Mo. The patents cover a finish for concrete tile which simulates a burned glaze. The tile is for use in mantels, store fronts and other decorative work.

The Interior System Architectural Hollow Metal—specifications and details for the use of interior hollow metal architectural work, put out by the Interior Metal Manufacturing Co., Jamestown, N. Y. It includes doors, bucks, jambs, transom sash, double hung and pivoted sash, casing trim, plinths, various moldings, dumb waiter and counterbalanced doors, elevator doors base and chair rails.

Airway Equipment for Industrial Painting, Bulletin No. 12 of the Binks Spray Equipment Co., 3114-26 Carroll Ave., Chicago. An air gun said to be equal to six men with hand painting methods. It is used to dust surfaces by air before paint is applied; the mechanism of the gun is such that no paint comes in contact with it, going only through straight passages in the control head. The equipment is used in the application of paints, enamels, lacquers, varnish, bronzing materials—any coating material that can be formed into a spray. The catalog also lists Binks Portable Airway compressors.

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375 Half Bag, the T. L. Smith Co., Milwaukee, Wis., a circular illustrative and descriptive of the little brother of the big Smith tilting mixer; furnished in two-wheeled type with pneumatic tires for extreme portability.

Truscon Steel Joist Data Book, by the Truscon Steel Co., Youngstown, Ohio, is a handbook of information containing accurate data on design and construction. It is 8½ in. x 11 in.; 32 pages; paper covers; fully illustrated by reproduction of photographs and drawings.

In the preparation of this book, it was the aim to present in concise, convenient form, the essentials, tables for designing, specifications and details so that architects, engineers, contractors and builders who have the book can lay out and design complete steel joist installations.

The safe loading tables included, give the carrying capacities of individual beams. Useful information on weight of floors, bending moments and deflection of beams for various methods of loading and coefficients for deflection is included. Specification for steel joists are given and the various accessories used with steel joists and their application illustrated.

Drafting Room Standards for All Types of Steel Windows by the Truscon Steel Co., Youngstown, Ohio. This is probably the most complete portfolio ever produced on steel windows and answers practically all of the hundred and one questions that architects and engineers can ask about steel windows. The architectural detail sheets are drawn to scale for tracing on plans.

A folio of complete specifications is included, covering practically every type of steel window and industrial steel door. This portfolio is in loose leaf form, size 8 in. x 10½ in. and new sheets will be furnished from time to time so that the portfolio will not grow old in the architect's files.

Smith Mixers, T. L. Smith Co., Milwaukee, Wis., 48 pages and cover, 7½ x 10½ in., describing and illustrating the Smith line of non-tilting concrete mixers, 4-S to 28-S sizes. The manufacturers direct attention to end to center mixing action, speedy discharge, and among the new features, the Smith water-measuring tank, and the use of rubber-tired wheels on certain sizes when specified.

Havemeyer Deformed Bar Reinforcement for Concrete Pavements, an 8½ x 11 in. circular, with 8 pages, illustrating and describing the product of the Concrete Steel Co., 42 Broadway, New York city, for the reinforcement of concrete roads and pavements. Bars are cut to length, bent where required and assembled in units or mats in the field by use of a portable assembly frame, being tied at the intersections with Bar-Tys which are so formed that they support themselves in a correct position on the subgrade. Types of reinforcement furnished include the following: Simple flat mats of deformed bars, self-supporting bottom reinforcement, top reinforcement, top reinforcement and marginal bottom reinforcement, and top and bottom reinforcement.

The Turbine Air Granite and Marble Polisher, catalog of The Turbine Air Tool Co., 301 Chamber of Commerce Bldg., Cleveland, Ohio; a hand tool operated by compressed air utilizing grinding discs, for finishing concrete either in units or in monolithic surfaces as well as for granite and marble. The catalog is descriptive of the operation and illustrates the parts.

Concrete Roofing Tile Machines, catalog issued by the Phoenix Tile Machine Co., Phoenixville, Pa., 20 pages and cover, 6 in. × 9 in., showing machines for making French and Spanish tile, together with molds for specials. The same company furnishes molds for caps, bases and pier blocks.

Duplex Construction is described in a catalog of The Duplex Construction Equipment Co., P. O. Box W, Campbell, Calif. Essentially for double walls with continuous air space. The units are 2½, 3 or 4 in. thick by 8 in. high and 16 in. long. They are grooved so as to lock as laid up, and the two sides or parts of the wall are tied together by metal bands which fit into the grooves. Fourteen-in. blocks are also made for the inside for joist courses. The units are made in a pressure machine weighing approximately 1,500 lbs. The molds are arranged on revolving tables, one mold being under the press while the other is being filled. This system of construction has been used in building houses in California.

Sampson Concrete Wall Construction, a 4-page circular with illustrations from detail drawings and photographs, issued by the Samson Concrete Wall Co., 717 East 140th St., New York city, showing a system of light wall construction, utilizing Samson sheathing and Samson welded fabric together with the Hodges stucco machine in building reinforced concrete walls 2¾ in. thick. The framework is built up on 4 x 6 sills laid on the foundation walls the same as for frame building, except that the outside face of the sill is kept back 2¾ in. from the outside face of the foundation. The frame is then erected with temporary shoring at the outside wall line to support the floor beams and with interior bearing partitions framed as in ordinary frame construction. The second floor beams are placed with a header at the exterior walls instead of a plate. After the first floor is framed, the second floor is framed in the same way, the exterior is then sheathed with Samson sheathing stapled to 2-in. x 2-in. furring securely nailed top and bottom. Window frames and door frames are secured in position, and the wall is then covered with Samson welded fabric. The floor beams of the second floor are eventually supported by a projection on the machine-placed concrete wall and the shoring removed.